Power Engineering

AUGUST, 1953

Volume 57, No. 8 Circulation of this issue 32,280

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TECHNICAL PUBLISHING COMPANY • CHICAGO, ILLINOIS

Space-saving rugged

Built, shipped and installed as a compact unit, the new Elliott geared turbine has many advanced features that fit it to the most exacting requirements. Here are some of them:

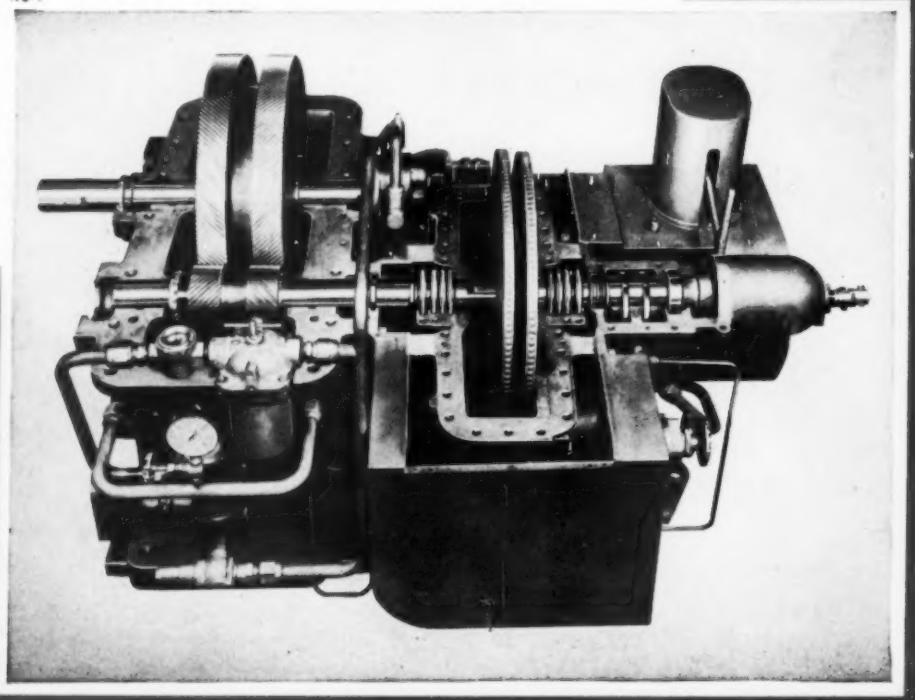
- **Turbine wheels and pinions mounted on a single sturdy high-speed shaft—**
- **Double-helical gears and pinions eliminate end thrust and the need for maintaining critical thrust bearing.**
- **Requires no base plate or external oil reservoir. Three-point support.**
- **Neatly arranged lubrication system, with all external oil piping connected to lower casing.**
- **Liner-type bearings . . . gear-type oil pump, self-priming . . . Kingsbury floating-ring type oil seals with slingers.**

Also built in coupled design, with pinion shaft flexibly coupled to the turbine.

only one of many vital factors in the new

ELLIOTT Geared Turbine

H3-1



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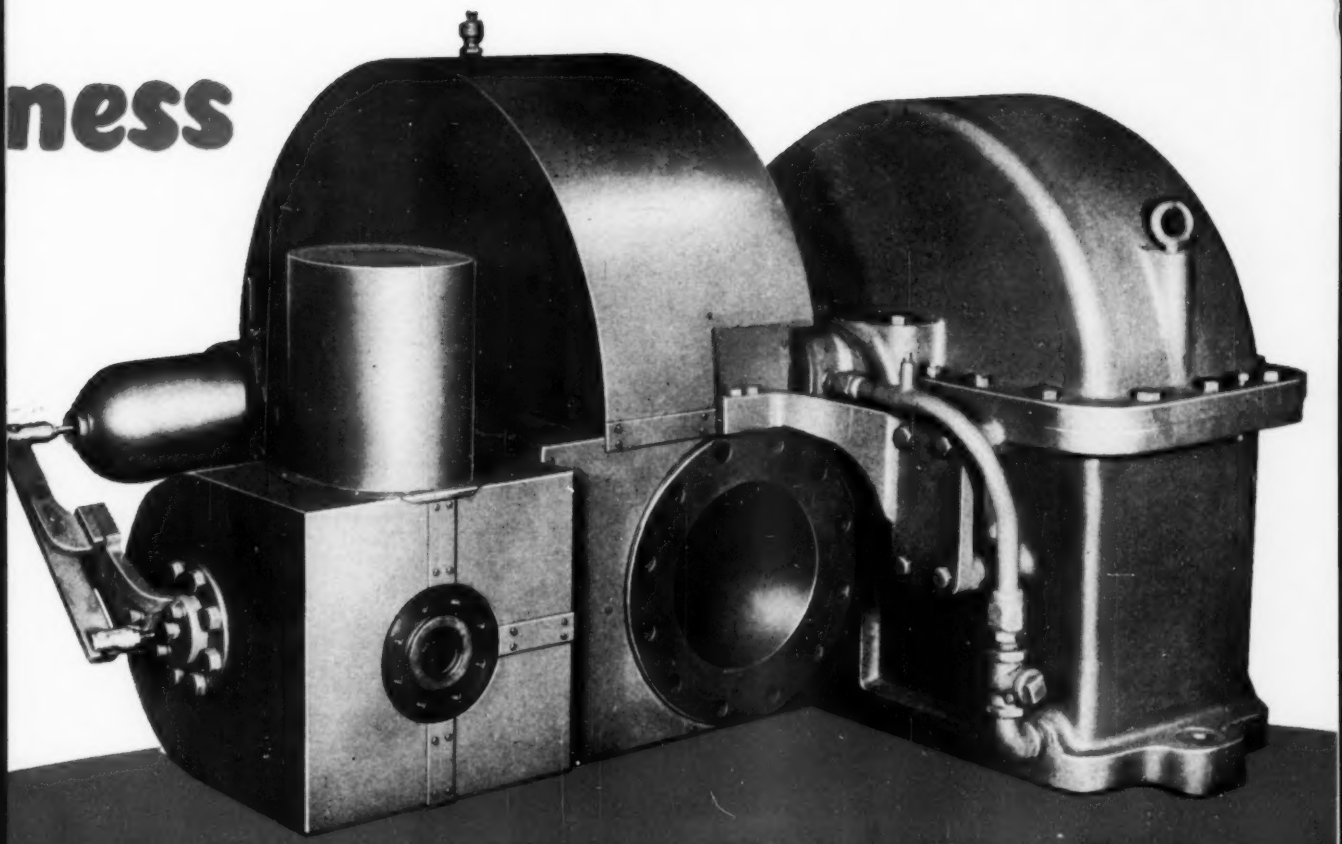


THE TURBINE

The new "built-in" Elliott geared turbine employs the sturdy and dependable YR turbine. This proved turbine design is adaptable to practically all operating requirements and is economical in both operation and maintenance.

Outstanding features are centerline support, stainless steel turbine buckets and shroud, dynamically balanced rotors, and the choice of several governors to be used with the standard overspeed governor. The wide use of standardized parts that fit all sizes of YR turbines simplifies maintenance and the stocking of parts.

Full details on the new Elliott Geared Turbines are given in Bulletin H-19, just released. Bulletin H-16 describes the YR turbine line. Contact your local Elliott district office or write Elliott Company, Jeannette, Pennsylvania.

THE GEARS

Gear and pinion are double-helical (herringbone) type, precision-hobbed, quiet, and long wearing. Tooth spacing is held to extremely close tolerances. Conservative proportioning of the teeth minimizes pinion deflection and permits a uniform, low tooth load.

Both the high-and low-speed gear shafts are provided with an oil slinger combined with a special seal. This design prevents leakage of oil from the gear case and eliminates the infiltration of water, steam, or impurities into the gear case.

All Elliott gears, built-in or coupled, include a self-contained, forced-feed lubrication system which circulates oil under pressure to both gear and turbine bearings. In addition, two spray nozzles in the top gear casing direct a sheet of oil continuously into the meshing point of the gear and pinion teeth, cooling the teeth and lubricating the contact area.

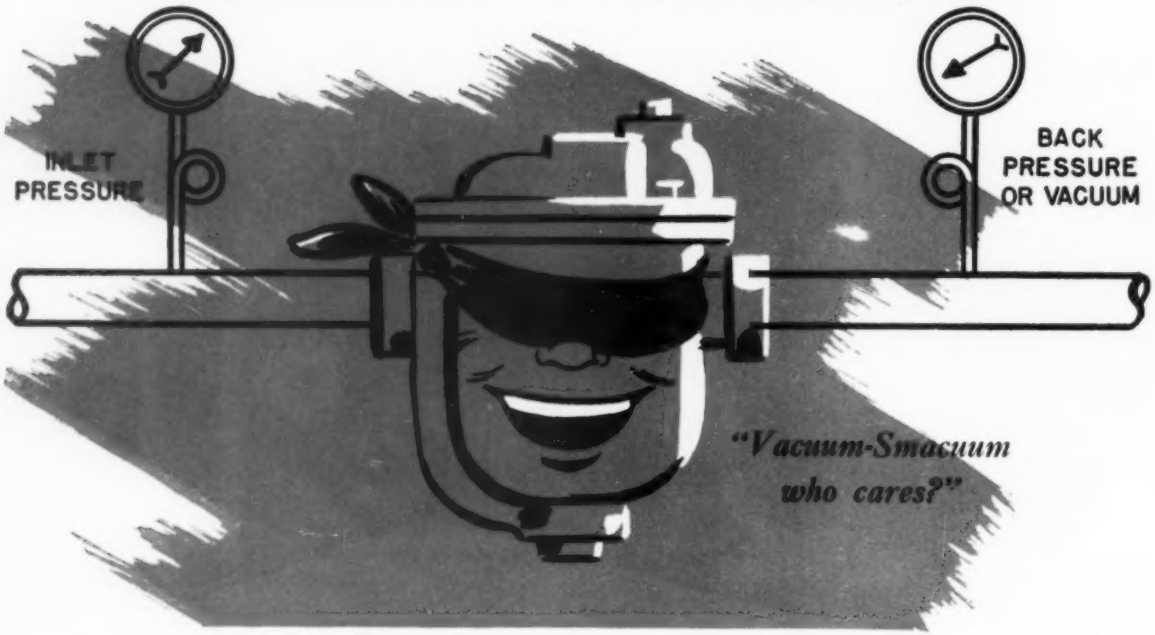
ELLIOTT Company

STEAM TURBINE DEPT.

VACUUM ISN'T VACUUM

TO A STEAM TRAP

. . . It's Just Pressure Below Atmospheric



ONLY 2½¢ per year per trap **parts costs on traps averaging 11 years of service at Globe Steel Tubes Company, Milwaukee, Wisconsin.**

PRACTICALLY ZERO maintenance, **complete satisfaction with traps after 12 years service on 10 lbs. pressure, 5" vacuum—Liquid Veneer Corp., Buffalo, N.Y.**

***Send for 4-page Bulletin No. 223, "Vacuum Isn't Vacuum"—a complete discussion of vacuum, effect on trap selection, causes of vacuum loss, effect of flash steam, etc. Free on request. Just fill in and mail the coupon.**

BUYERS are sometimes told that steam traps for vacuum return service must be "different"—requiring, we suppose, some mysterious ability to recognize vacuum and act accordingly.

The truth is that vacuum isn't vacuum to any steam trap. It is just pressure below atmospheric pressure. All vacuum does is increase the pressure differential across the trap orifice. An Armstrong trap doesn't care whether it discharges to vacuum, back pressure or atmosphere. It works just the same in all cases.

Because Armstrong traps don't have to wait for condensate to cool, drainage is fast and equipment temperatures and BTU output are maximum.

Armstrong traps won't cause you to lose vacuum. Any flash steam from their discharge is quickly condensed. *It is the leaky traps that make it hard to hold vacuum!*

The mechanisms in Armstrong traps for low pressure vacuum return service are identical in design, workmanship and materials to those used in traps for 900°F, 950 lbs. pressure. They can't help but operate a long, long time without leaking. This makes it nice for the maintenance man, too.

Fast heat-up, high temperatures, low maintenance, long life—all wrapped up in one package. Ask your Armstrong Representative to go over your vacuum heating system with you.

ARMSTRONG MACHINE WORKS
810 Maple St., Three Rivers, Michigan

ARMSTRONG MACHINE WORKS
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Please send Bulletin 223, "Vacuum Isn't Vacuum"

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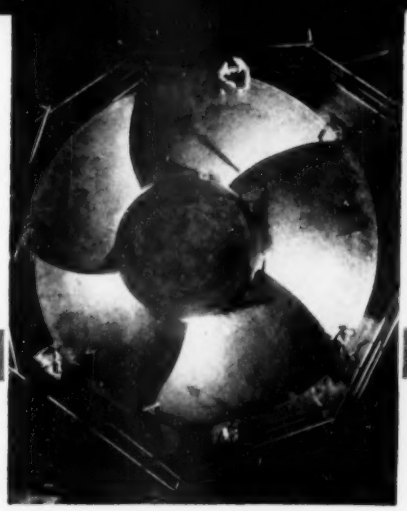

Grinders at work on a propeller-type hydraulic turbine impeller at Allis-Chalmers' plant

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The only magazine devoted exclusively to the job interests of power engineers

NEW BOILER WATER CONDITIONING PACKAGE

Adjust-O-Feeder
Model 1105-S

- LOW COST
- COMPACT
  Built-in standard motor — no separate gearbox or couplings.
  Built-in oil-enclosed gear reducer.
- MICRO-STROKE ADJUSTMENT
  Scale easily read — crank and connecting rod operate in horizontal plane.
- LONG LIFE AND EASY MAINTENANCE
  One-piece Meehanite iron frame for positive alignment of all moving parts.
  Double check valves on suction and discharge easily removable.

This new, compact chemical feed pump, by %Proportioneers, Inc.%, is inexpensive and provides accurate boiler water treatment for plants where a low capacity, medium pressure pump will meet requirements. The standard Model 1105-S has a capacity range from 1 to 10 GPH and will discharge against pressures up to 650 psig. For lower feeds, the unit is available with a range of from 0.5 to 5 GPH. Complete and self-contained, Model 1105-S weighs less than 100 lbs. and is ready to operate.

Ask for Bulletin 1105

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Write to %PROPORTIONEERS, INC.%, 385 Harris Ave., Providence 1, R. I.

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

For more data circle 503 on Post Card

ENGINEERS' PREVIEW

SOUTHERN California Edison Co. has ordered a 125,000/156,250-kw turbine generator unit, with a 10,000-kw auxiliary generator, from the Westinghouse Electric Corp. One of the largest single-shaft turbine generators on order, the unit will be installed at Redondo Beach Steam Station No. 2, about 25 miles southwest of Los Angeles.

The turbine is designed for 1800 psi steam pressure, and 1000 F temperature, with reheat to 1000 F. It will be a three-cylinder, triple-exhaust turbine. The generator will be of the hydrogen-cooled type, and will generate at 18,000 v. Shipment of the equipment is scheduled for late 1954.

* * *

RED FACE DEPARTMENT. Yes, we know now. That item about the Saxon and the Cossack, on page 8 of the June issue, was not written originally by Commodore Oliver Hazard Perry, as we said, but instead by his brother, Matthew C. Perry, also a Commodore. We should have suspected that, because Oliver Hazard Perry, according to the records, died in 1819, whereas his brother Matthew died in 1858, two years after the statement quoted. With all that, it is still a mighty interesting and significant statement for anybody to make in 1856.

* * *

TWO OHIO ELECTRIC utility companies are winners of the first More Power to America Award, of the Edison Electric Institute.

The Cleveland Electric Illuminating Co. took national honors in the division which includes utilities having 250,000 meters or more, while the Dayton Power and Light Co. was winner in the division having up to 250,000 meters. Each of the winners received a plaque and a cash prize.

First award for the national leadership in the field of industrial electrification, the More Power to America Award is offered by the General Electric Company and is presented through the Edison Electric Institute.

* * *

AFTER 33 years of service with the Los Angeles Department of Water and Power, Charles P. Garman, assistant general manager and chief engineer since 1951, retired early this year. He had started his electrical career with the Dayton Power and Light Co., went to Los Angeles in 1911, but two years later returned to his home town. After seven more years with Dayton Power and Light Co., during which time he advanced to the position of superintendent of meters, he returned to Los Angeles in 1920, and joined the Department of Water and Power as a draftsman.

He steadily advanced through the positions of engineer of design, engineer of design and construction, assistant chief electrical engineer, chief electrical engineer to assistant general manager and chief engineer. Among the major power system projects with which Mr. Garman has been identified are the Boulder transmission line system, the Harbor and Valley steam generating plants and the Owens Gorge hydroelectric development.

FOR THE BEST preview of the future, keep your eye on the comic strips. Science finally has caught up with Dick Tracy and broken his monopoly on the wrist-watch-radio transmitter and receiver. Right out of the comic strips into reality it has come, as shown in the accompanying picture. Complete radio transmitter like this, incorporating transistors and all circuit elements, was demonstrated at the North Eastern District Meeting of the American Institute of Electrical Engineers at Boston, by R. L. Wallace, Jr., of the Bell Telephone Laboratories, Inc. The transmitter was pinned to Mr. Wallace's shirt and was powered by a tiny battery in his breast pocket, and he carried an antenna about as big as a pack of cigarettes. His voice was picked up in another room and amplified so it could be heard throughout the Sheraton Plaza Hotel where more than 800 electrical engineers held their annual spring meeting.

R. L. Wallace, Jr., demonstrating complete radio transmitter in his shirt pocket at the AIEE Meeting

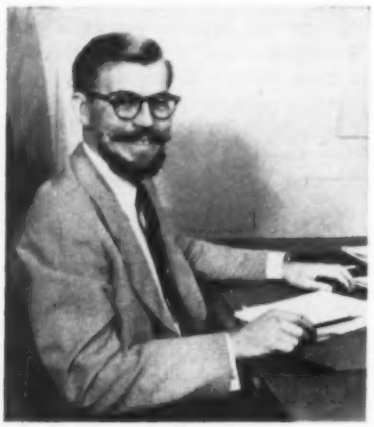
* * *

NATIONAL SAFETY COUNCIL has just published a 1953–54 edition of the National Directory of Safety Films. It contains a comprehensive listing of 963 motion pictures and slide film for use in training personnel in occupational accident prevention. The Directory will be kept up to date with supplements, published quarterly. Copies available for 75 cents each from National Safety Council, 425 North Michigan Ave., Chicago 11, Ill.

The council also has a new handbook of Accident Prevention for Business and Industry, specially designed for small business or the supervisor of a department in a large organization. It advises the small business man, who cannot afford to employ a full time safety specialist, how to use outside assistance. It includes several check lists and is illustrated profusely. For further information and prices on it, write the National Safety Council.

Finally, there is a new free booklet, Service Guide 2.1 Occupational Safety Services, showing all the varied accident prevention aids available from the council.

BEAVER! And a ten dollar one at that! This is the last public view of the whiskers of Carl Raines, General Electric turbine installation engineer, as preserved for posterity by a photographer as Raines was writing his report on starting up the first 62,500-kw



Carl Raines with beaver

GE turbine generator at Bokaro Steam Station in India. He grew the mustache and the beard while in India this Spring, and delayed shaving for a few days after his return to the United States. A few hours after the photo was taken, he shaved them off.

* * *

THERE doesn't seem to be any excuse for high school graduates failing to obtain a college education now-a-days, at least for financial reasons. Midwest industry is making it increasingly easy. "During the past academic year," according to Clarence E. Deakins, dean of students at IIT, "441 students, nearly a quarter of our full-time enrollment, obtained financial help in the form of a scholarship of some kind. The scholarships' total monetary value was $264,000." In addition to the scholarships sponsored by industry, which needs scientists and engineers, another point in the high school student's favor is the co-operative plan, in which the student alternates study semesters with semesters working for industry in his field. Many students are able to support themselves in this way and in five years will have enough credits for a degree and, in addition, about 2½ years of practical experience.

* * *

GIVE EAR! all you bald old bucks who grew up with the good old reciprocating steam engine! And, incidentally, there are lots of old ones — engines, that is — and a great many new ones giving very good service today. But again — hearken! Did you know that if you own and operate an Elliott (Ridgway) steam engine or a Chuse, or an Ames, you can obtain parts and service for them from Skinner Engine Co.? Skinner has acquired all Elliott and Ames drawings, records, inventories, tools and patterns for such engines. Incidentally, Skinner also has developed a new design of steeple-compound unaflow single-acting steam engine, designed primarily for powering new twin screw vessels, the car ferries *Spartan* and *Badger*. We'll show you a cross-section of this engine in a future issue.

ATOMIC POWER REPRINTS AVAILABLE

WE HAVE RECEIVED so many requests for tear sheets of the article "Sources of Information on Atomic Power," in the July issue, that we have had reprints made of it to send free to those wishing a copy. To obtain a copy, merely write "Source" on the prepaid post card on page 35 or 137 of this issue and mail it to us. Your copy will be mailed at once.

We also have available a number of copies of the Atomic Power Section published in the June issue. For a reprint of this section, just write "Atomics" on the post card and mail it to us.

* * *

ONE OF THE nation's youngest electric utility companies, with only a single customer, won the electrical industry's top honor when Electric Energy, Inc. was presented the Charles A. Coffin Award for outstanding achievement during 1952. This was done during the Edison Electric Institute's 21st Annual Convention at Atlantic City. The award-winning company, established in 1950 to supply electric power to the AEC project at Paducah, Ky., was given the award for vision, initiative, and courage in pioneering action by a group of electric utility companies to handle power loads larger than one company could handle alone, and in building new generating facilities for this purpose.

* * *

PROPANE gas has been used for the first time as fuel for one of the Union Pacific gas turbine electric locomotives, according to a recent report by UP. The report does not say whether or not it was liquefied, but we presume it was, for convenience in carrying on the locomotive. The new development is the result of joint research by Union Pacific, Richfield Oil, and General Electric. Union Pacific said it plans to place this and similar locomotives in regular freight service between Los Angeles and Salt Lake City.

* * *

FRED D. MOSHER will be the new district sales agent of Erie City Iron Works for the Buffalo-Rochester-Erie area. He is a graduate mechanical engineer from Brooklyn Polytechnic Institute and did post graduate work at Pratt Institute and New York University. He has served as operating engineer and boiler inspector in New York State, and has been a research engineer on forced circulation and integral furnace boilers, on firing of gas turbine power plants, and on special locomotive stokers. He is a member of ASME and author of over 100 papers and technical articles, some of them published in POWER ENGINEERING.

* * *

NORTON CO.'s new $6,000,000 grinding machine plant suffered damage estimated at over $1,000,000 in a disastrous 10-min tornado that hit Worcester, Mass., on June 9. Damage was limited primarily to the building itself. The steel decking of the roof was blown hundreds of yards, windows were blown out, sidings stripped off, although the structural members themselves suffered practically no damage. Water from broken pipes, broken glass, and debris filled the entire factory and office area. Fortunately, nobody was killed at the plant and only about eight were injured, because employees had warning of the tornado and had presence of mind to take cover. The plant was back in production 62 hours later.

curious?

Furnace Operators! A little curiosity about this amazing FREE service can pay big dividends. *It's the Cities Service Heat Prover*. . . "not an instrument you buy, but a service we supply!" This unique instrument offers rapid, continuous sampling . . . simultaneous reading and direct measurement of oxygen and combustibles . . . and easy portability. We maintain the Heat Prover free of charge! It's not a curious fact that so many furnace operations have been bettered with the Heat Prover. Find out how and why the Heat Prover can increase furnace productivity for you. Call or write your nearest Cities Service Office or write Cities Service Oil Company, Dept. H17, Sixty Wall Tower, New York City 5, N.Y.

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QUALITY PETROLEUM PRODUCTS

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new

WIDER VISION

for easier remote boiler water level readings

■ Vastly improved visibility of remote boiler water level readings can now be enjoyed by boiler plant operators.

The new "wide vision" face on Yarway Remote Liquid Level Indicators allows reading from the side as well as the front of the indicator.

Boiler water levels and other liquid levels can be checked from most any position in the control room or wherever the Yarway Indicator is installed.

Indicating mechanism is operated by the boiler water level itself, assuring instant, accurate readings. Indicating mechanism is never under pressure. There are no stuffing boxes.

Over 10,000 Yarway Remote Liquid Level Indicators are successfully used throughout industry—primarily for indicating boiler water levels, but also other liquid level applications, and for super-heater pressure differential indication aboard ship.

APPROVED MANOMETRIC TYPE

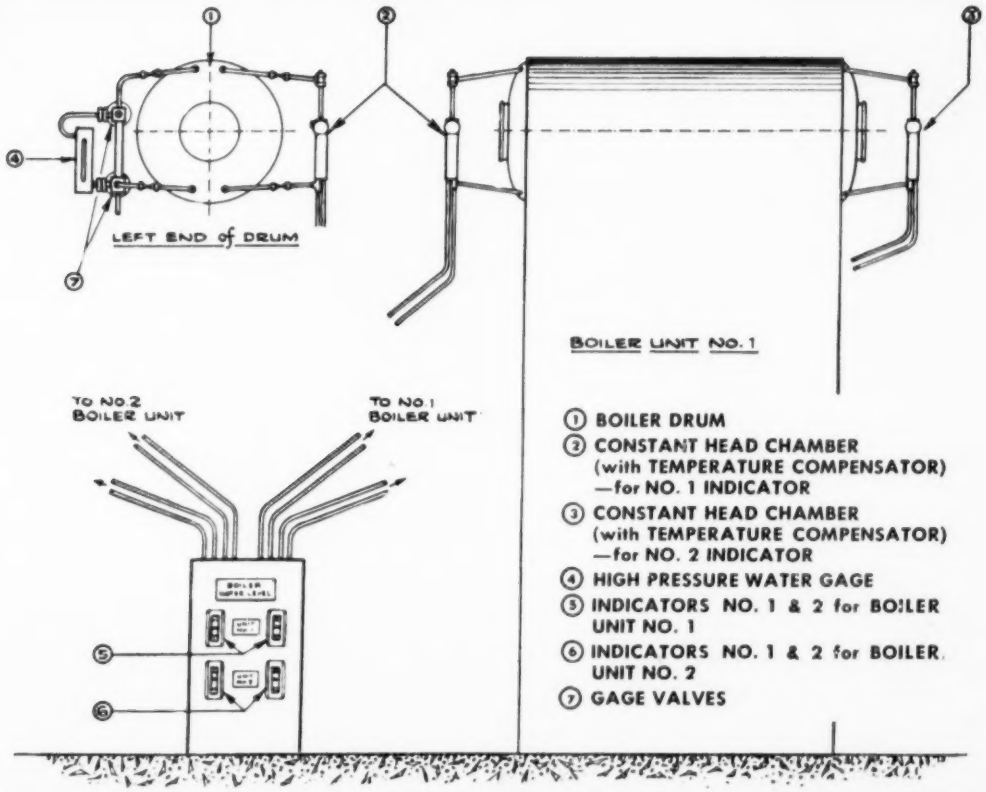
Yarway Remote Liquid Level Indicators are of the manometric type, with automatic temperature compensation, as approved for use under the new ruling of the A.S.M.E. Boiler Code Committee as covered in Code Case #1155, which permits the use of two remote indicators in place of one of the high pressure boiler water gages on boilers over 900 psi.

Additional information—write

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

Yarway Remote Water Level Indicator is of the manometric type with automatic temperature compensation. Note new "wide vision" face See Yarway Bulletin WG-1823.

Suggested installation of Yarway Remote Liquid Level Indicators and High Pressure Water Gages as now permitted by the A.S.M.E. Boiler Code.


LEFT END of DRUM
BOILER UNIT NO. 1
TO NO. 2 BOILER UNIT
TO NO. 1 BOILER UNIT
① BOILER DRUM
② CONSTANT HEAD CHAMBER (with TEMPERATURE COMPENSATOR) —for NO. 1 INDICATOR
③ CONSTANT HEAD CHAMBER (with TEMPERATURE COMPENSATOR) —for NO. 2 INDICATOR
④ HIGH PRESSURE WATER GAGE
⑤ INDICATORS NO. 1 & 2 for BOILER UNIT NO. 1
⑥ INDICATORS NO. 1 & 2 for BOILER UNIT NO. 2
⑦ GAGE VALVES

YARWAY® remote liquid level indicators

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YOU CAN'T PREVENT SLUDGE...BUT YOU CAN

CONDITION SLUDGE

...with Dearborn Formula 659

● Sludge—the ever-present thief of boiler efficiency—can be controlled with Dearborn's sludge-conditioning Formula 659.

IMPORTANT FUNCTIONS OF FORMULA 659

PREVENTS sludge from adhering to boiler surface.

PROVIDES colloidal action; prevents crystalline scale formation.

PRODUCES better quality steam by modifying bubble formation responsible for foaming conditions.

ELIMINATES corrosion in feed lines, heaters and internal boiler surfaces caused by dissolved oxygen.

Compatible with other treatments, this Dearborn formula will greatly reduce maintenance and production costs.

Dearborn

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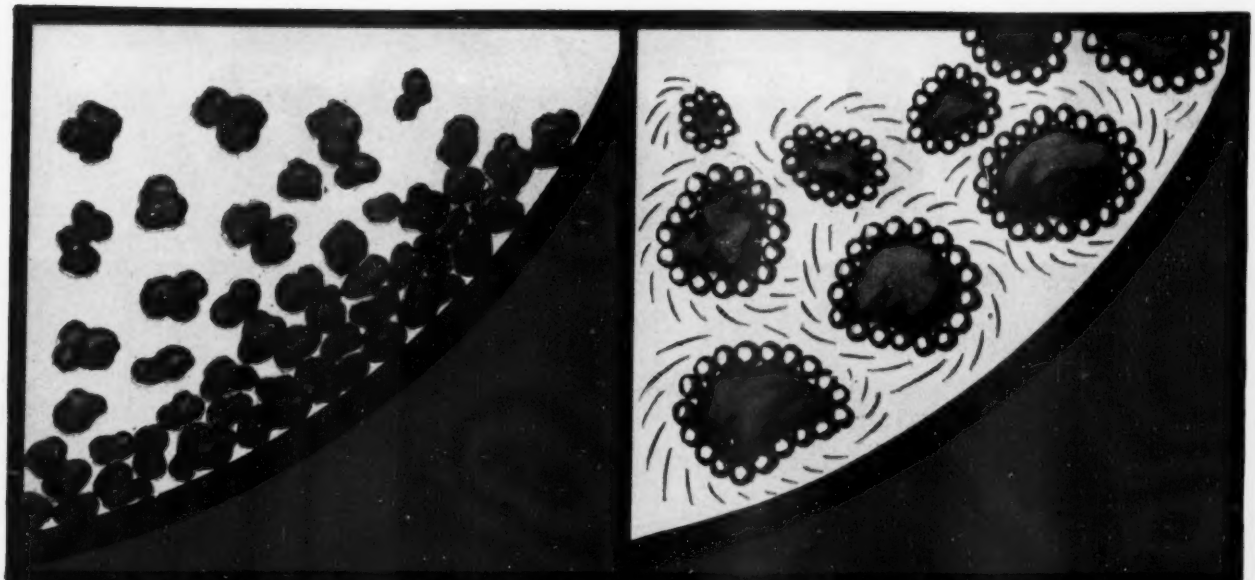
COMBATTING CORROSION EVERYWHERE SINCE 1887

DEARBORN CHEMICAL COMPANY · Merchandise Mart Plaza, Chicago 54, Illinois



THIS IS UNCONDITIONED SLUDGE
Untreated sludge particles settle into a compact mass, preventing water contact with metal surfaces and producing sludge-type scale.

THIS IS CONDITIONED SLUDGE
Treated sludge particles, surrounded by water molecules, produce fluid and non-adherent particles which prevent packing and attachment.

DEARBORN FORMULA 134 REMOVES SCALE

Many waters tend to form scale in pipes and cooling jackets, impairing valuable equipment, adding unnecessary labor and shutdown time. Formula 134, a concentrated solvent, removes scale in heat exchange units, boilers, pumps, feed lines, meters and condensers! Bulletin 5002 describes removal of scale with Dearborn Formula 134.

DEARBORN Filmeen Stops Return Line Corrosion

If corrosion makes frequent replacement of return lines, fittings and other equipment necessary, your plant engineer will want to know more about corrosion control with Dearborn Filmeen . . . Bulletin 5013 gives the complete story.

your Dearborn Engineer

will visit your plant, analyze the pertinent waters, make recommendations for the proper treatment and the equipment necessary to establish a simple control that eliminates unnecessary expense.

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Merchandise Mart Plaza
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Dept. PG

Please send me

- ☐ Bulletin 5008-A—Dearborn Formula 659
- ☐ Bulletin 5000 —Dearborn Industrial Water Treatment and Engineering Service
- ☐ Bulletin 5013 —Dearborn Filmeen
- ☐ Bulletin 5002 —Dearborn Formula 134
- ☐ Have a Dearborn Engineer call

Name.....

Position.....

Company.....

Address.....

City.....*State*.....

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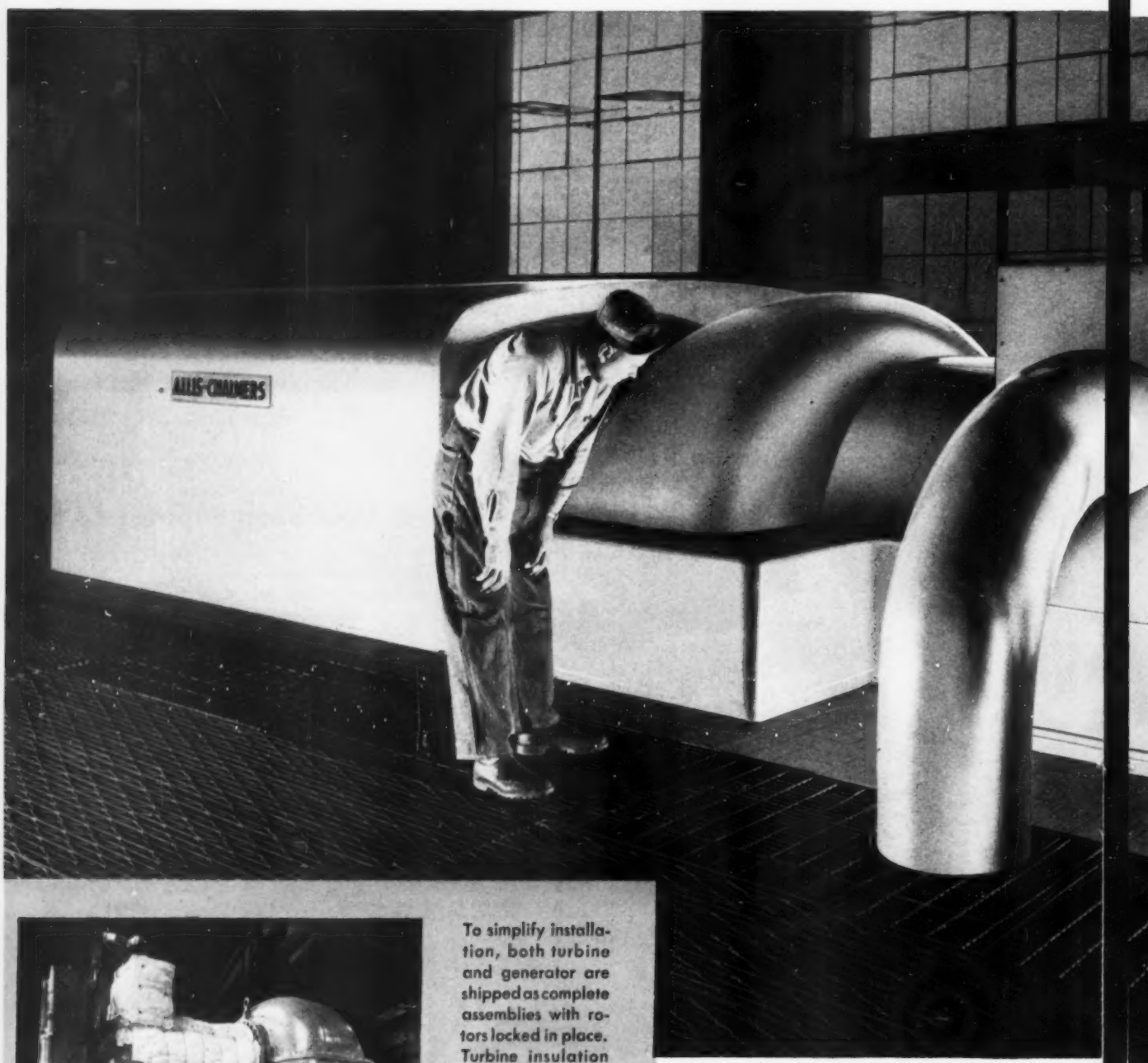
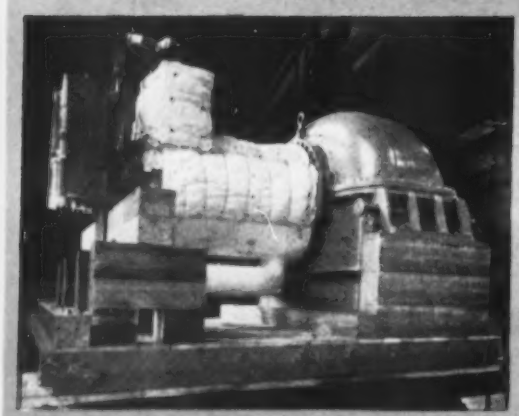
Another

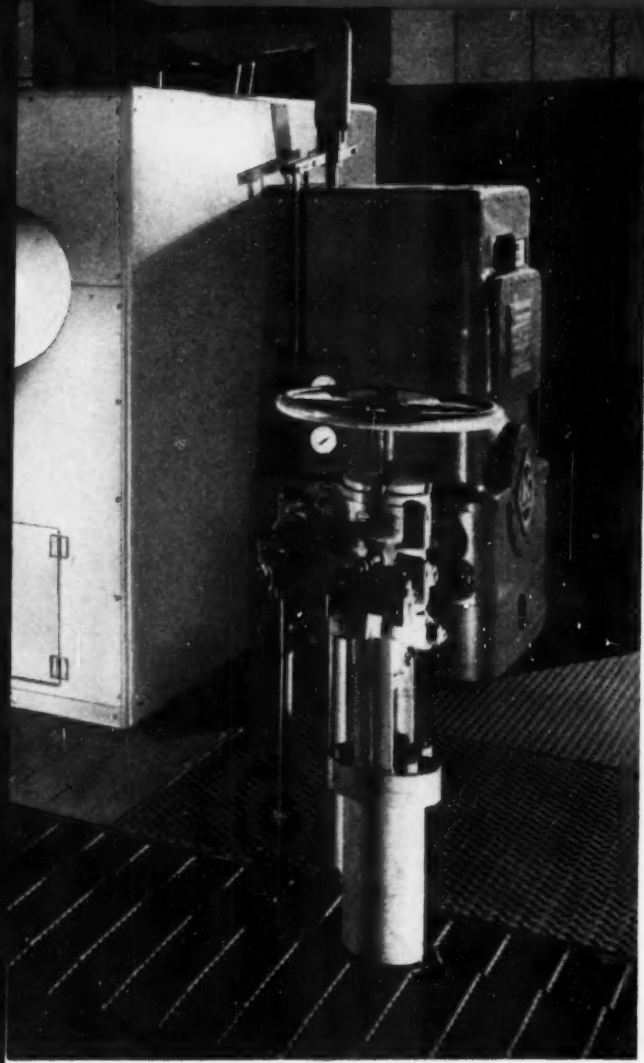




To simplify installation, both turbine and generator are shipped as complete assemblies with rotors locked in place. Turbine insulation is also applied at factory. Illustration at left shows 7500-kw turbine ready to be covered with tarpaulin before shipment.

Attractive appearance of WA-Series turbine and generator is shown above. Unit is rated 7500 kw, with steam conditions of 600 psig, 825 F, 1½ inches mercury absolute. A-C also supplied surface condenser, pumps and motors for this installation.

WA-Series STEAM TURBINE GENERATOR UNIT



Engineered to Meet Requirements of a Modern Power Plant!

HERE'S another Allis-Chalmers WA-Series turbine generator unit with the kind of design features and performance that power producers everywhere are looking for today.

Available for condensing and non-condensing service, the up-to-date WA-Series impulse turbine design is built in sizes 2000 kw and larger in NEMA standard ratings. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

Simplicity is Keynote

For ease of installation and maintenance, every detail has been designed to assure maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit with simple foundation requirements. And shipment of the turbine and the generator with their rotors in place further minimizes installation costs.

Completely coordinated in design, these modern generating units are manufactured, assembled and tested in one plant under unified supervision.

For a detailed story of the WA-Series features that can help you reduce costs, ask your A-C representative for Bulletin 03B7654, or write to Allis-Chalmers, Milwaukee 1, Wis.

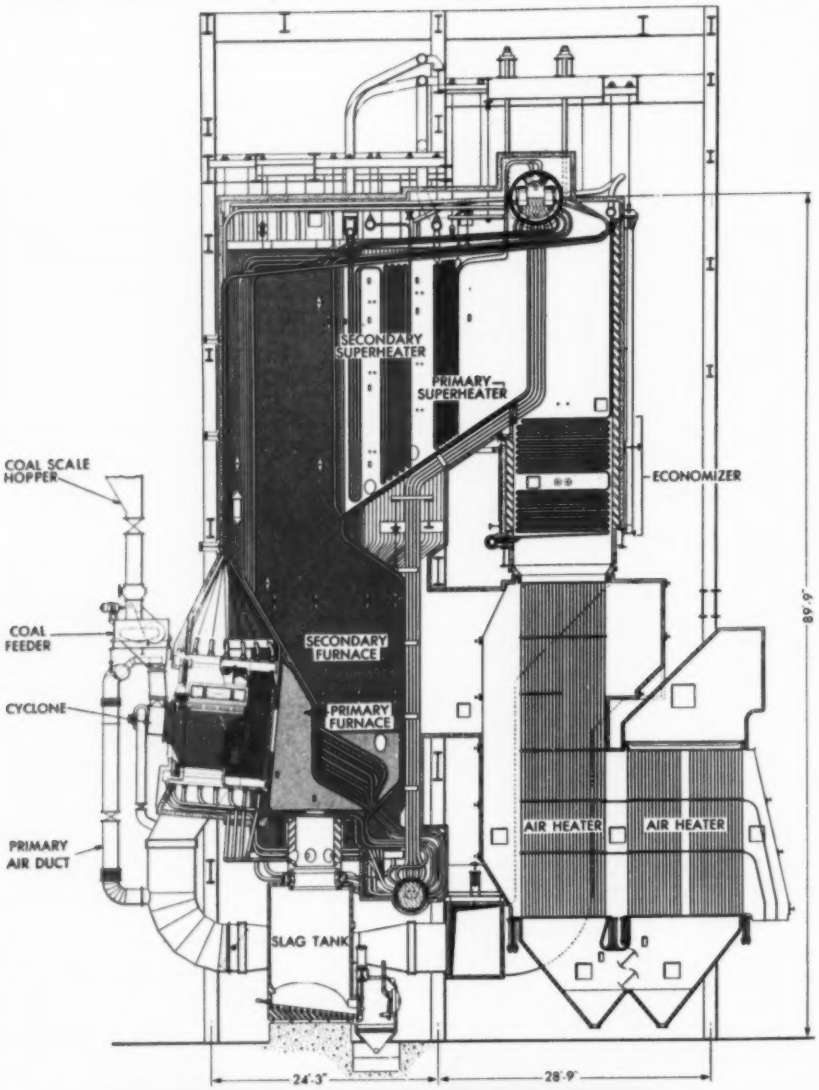
A-4112

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

WISCONSIN POWER AND LIGHT

on the line

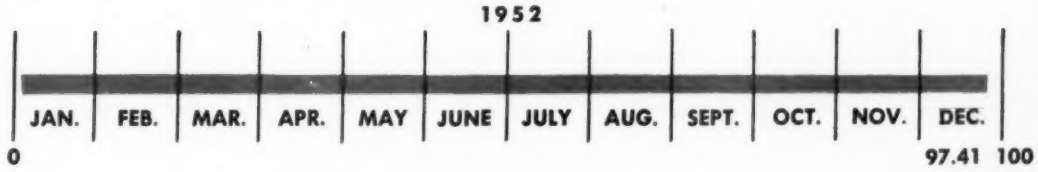


B&W CYCLONE-FIRED RADIANT BOILER

This unit has a steam generating capacity of 600,000 pounds per hour, with superheater outlet conditions of 1325 psi and 960F. It has a design pressure of 1525 psi and employs natural circulation. The boiler is equipped with a superheater, an economizer, and a vertical tubular air heater.

COMPANY'S CYCLONE-FIRED BOILER

97.41% of the year



at EDGEWATER PLANT

This outstanding record for a coal-burning unit was established during 1952 by the operators of Wisconsin Power and Light's Cyclone-Fired B&W Radiant boiler at the Edgewater Plant.

Cyclone Furnaces make a major contribution to high availability because they eliminate so much of the coal preparing equipment that is a source of continuous maintenance and possible outage. Cyclones burn coal that is merely crushed, not pulverized. This means that banks of many pulverizers, with their moving parts, motors, fans, lubricating systems, burners, piping and ducts, are eliminated. They are replaced by a few sturdy, simple Cyclone Furnaces.

Ease of operation and increased safety with the Cyclone Furnace are also important factors that mean sustained on-the-line performance. There are far fewer burners to light with Cyclone Furnaces, and because they use crushed coal, they eliminate the danger of furnace explosions that might occur with powdered fuel.

Further, by keeping the ash where it belongs—in the furnace—and severely reducing the amount of fly ash in the combustion gas, the Cyclone Furnace further contributes to high levels of operation. Ash accumulations on boiler and other surfaces are curtailed, and wear on boiler parts, and on machinery such as induced-draft fans, is greatly reduced.

Increased availability is just one of the many advantages to be obtained from Cyclone Furnace Firing. Other important benefits include reduced atmospheric pollution and a money-saving solution to the fly-ash problem, reduced cost of maintenance, greater efficiency, and boiler-room space savings.

Twenty B&W Cyclone-Fired Boilers are now in operation and have a total accumulated service time of over 50 years. Many other Cyclone-fired boilers are under construction.

We will be pleased to discuss with you the many positive advantages which Cyclone Furnace Firing can contribute to your operations. The Babcock & Wilcox Co., Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX
BOILER DIVISION

G-609

For more data circle 508 on Post Card

Harnessing heat for all industry

HEAT is one of man's most useful servants. With it, he can separate gasoline from crude oil . . . cook food . . . generate electricity . . . refine steel from raw ore and roll it into mile-long sheets. But to do these and countless other jobs, heat must be applied in the correct amounts . . . to obtain critical temperature values.

Forward-looking research and production men realized some years ago that "rule of thumb" was entirely inadequate for replacing complex processes. They needed facts obtainable only from automatic measurement . . . performance possible only through automatic control.

Honeywell has consistently led the way toward new and better temperature instrumentation. Continuing research has developed sensing elements which cover the full temperature spectrum . . . instruments which provide the desired accuracy . . . and automatic controls which can regulate any production process.

instruments

The complete Honeywell family offers a broad choice of characteristics to suit individual applications. *ElectroniK* indicators, circular chart and strip chart recorders and controllers afford the peak in performance through "Continuous Balance" high-speed electronic measurement. *Pyr-O-Vane* millivoltmeter instruments fit many processes which need accurate indication and control. Brown Thermometers are economical instruments for recording and controlling moderate temperatures.

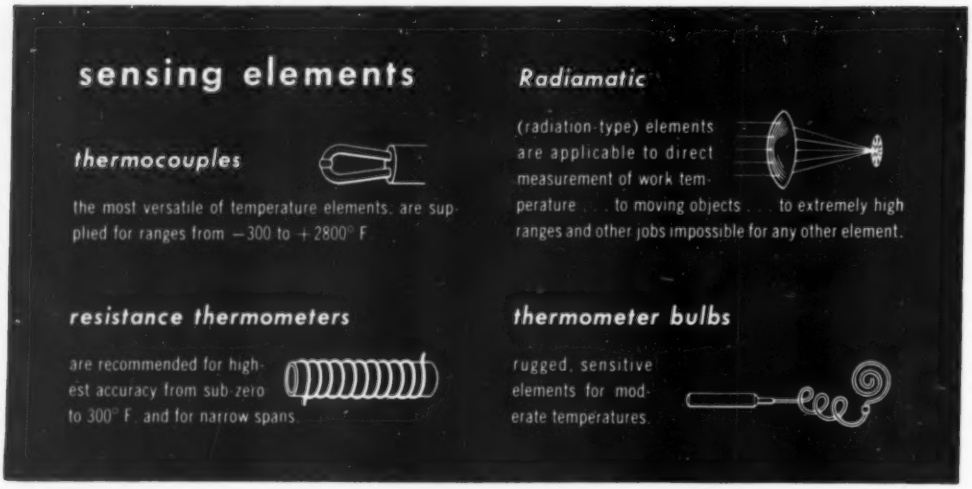
controls

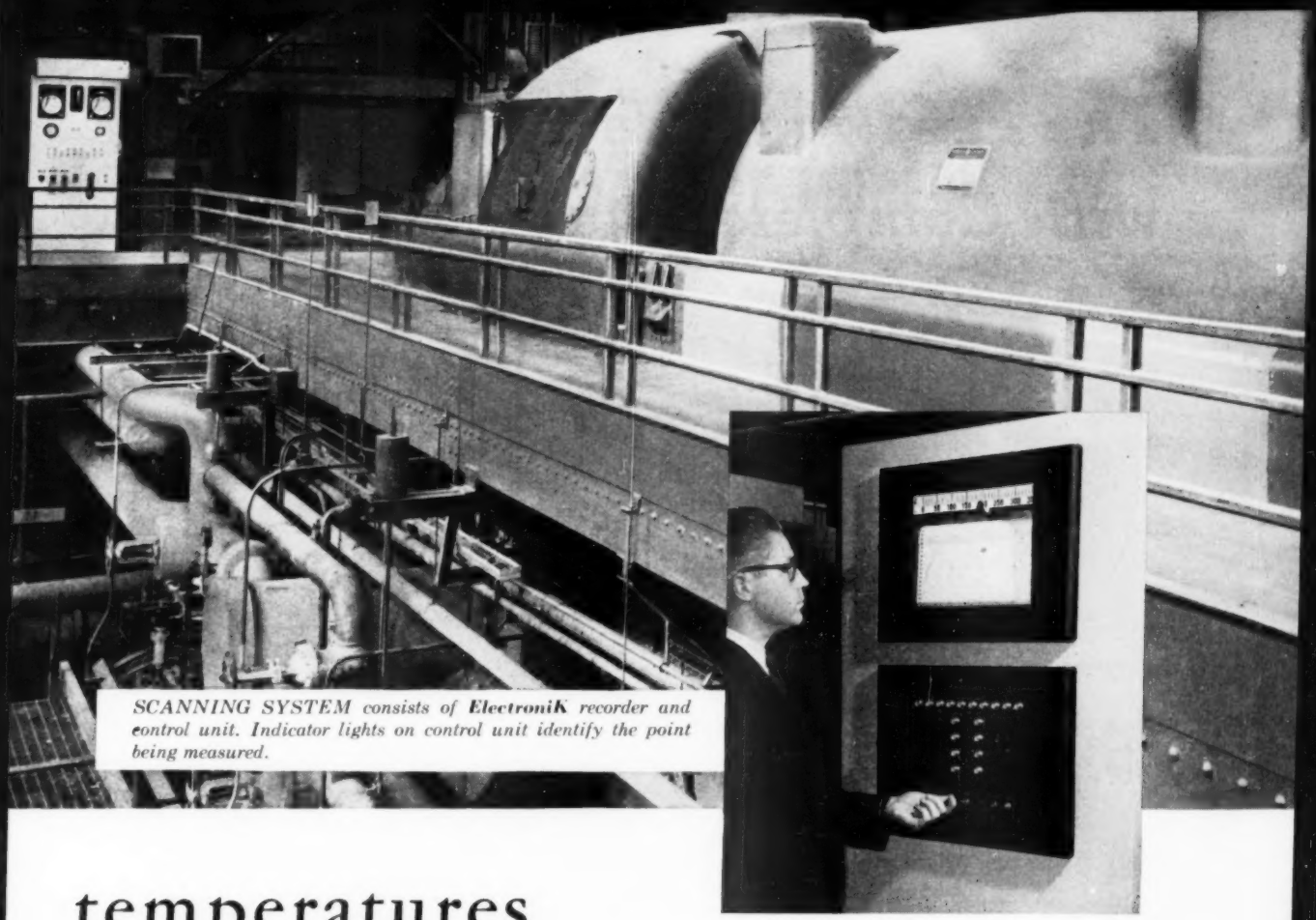
With *Pyr-O-Vane* instruments you can have electric control of either the two-position, three-position or time-proportioning types.

With Thermometers, you may choose from electric two-position, pneumatic on-off or proportioning control, and cam-operated program control.

With *ElectroniK* instruments, your selection covers practically any form of electric or pneumatic control, including the most advanced types suitable for complex processes, and the most flexible program controls.

Watch 270 plant *with the*


sensing elements
thermocouples
the most versatile of temperature elements, are supplied for ranges from −300 to +2800° F
Radiamatic
(radiation-type) elements are applicable to direct measurement of work temperature . . . to moving objects . . . to extremely high ranges and other jobs impossible for any other element.
resistance thermometers
are recommended for highest accuracy from sub-zero to 300° F. and for narrow spans.
thermometer bulbs
rugged, sensitive elements for moderate temperatures.



SCANNING SYSTEM consists of ***ElectroniK*** *recorder and control unit. Indicator lights on control unit identify the point being measured.*

temperatures *ElectroniK* scanner

IT'S EASY and economical to keep constant watch over temperatures of potential trouble spots throughout the plant, when you have an *ElectroniK* Scanning System. From a central point, you can monitor temperatures of bearings, hydraulic couplings, boiler tubes, cooling oil lines . . . at surprisingly low cost per point.

This instrument can concentrate data from as many as 270 different locations. It scans through successive thermocouple points at a rate as fast as one second per point . . . re-checking each point at approximately four-minute intervals.

At the operator's choice, it can perform these various functions: simple scanning without recording, continuous recording of all 270 points, selective recording, recording of points which depart from specified limits, and operation of annunciator contacts when any temperature exceeds a pre-set point. The chart moves only when the instrument is actually recording. Separate temperature limits can be set for each bank of 9 thermocouples.

Your local Honeywell engineering representative will be glad to discuss how this instrument can help you protect plant equipment economically. Call him today . . . he is as near as your phone.

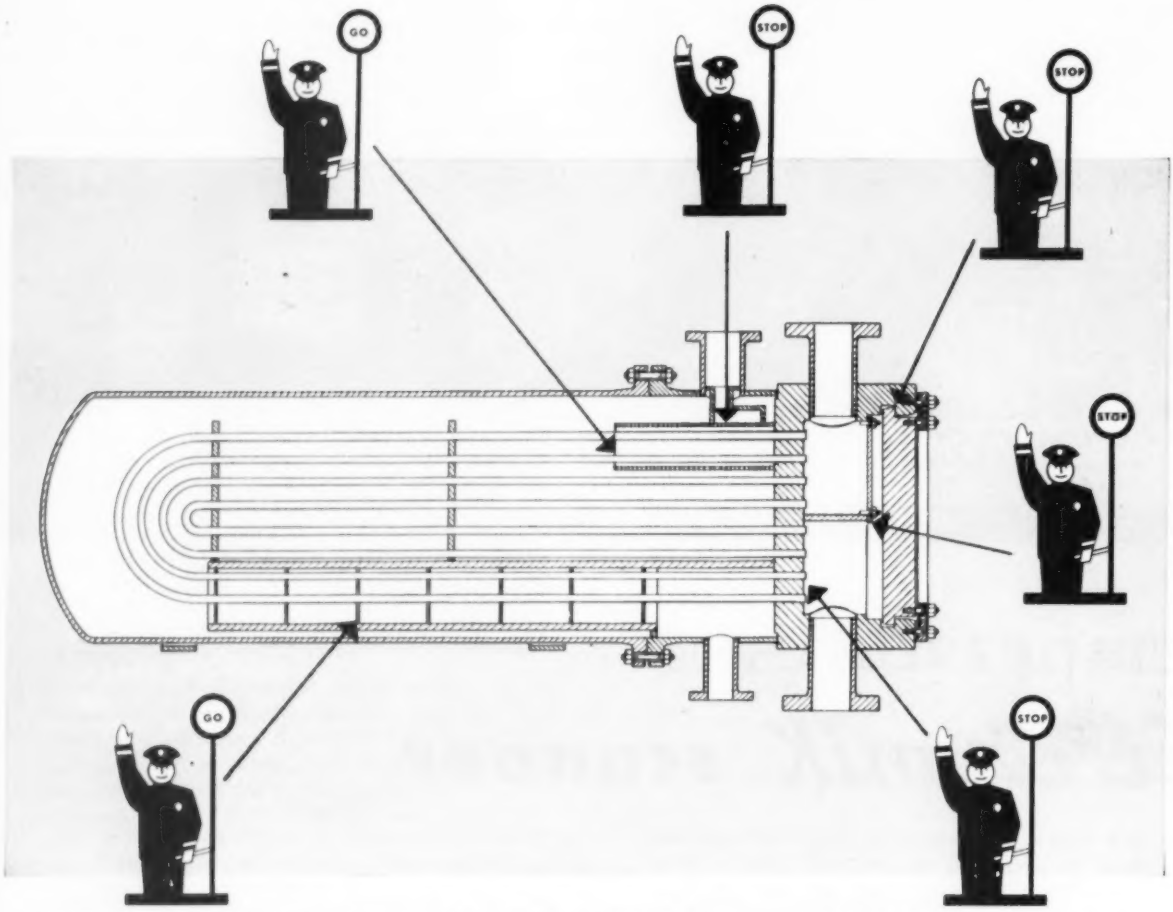
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Penna.

● **REFERENCE DATA:** Write for Data Sheet No. 10.0-9, "*ElectroniK* Scanning System," and Catalog 90-2, "Supervisory Instruments for Power Generation."

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

For more data circle 509 on Post Card

The Feedwater Heater with Complete Traffic Control



Traffic control in a feed water heater? Quite necessary, when you consider how inefficient the heating effect would otherwise be. Imagine the confusion of eddy currents and the consequent severe tube erosion if the steam entered without proper guidance.

In G-R Feedwater Heaters, control of both steam and water is complete and effective—the result of three quarters of a century's experience in the design of heat transfer apparatus by The Griscom-Russell Company.

Where the steam enters these G-R Heaters, its flow is first directed by an impact baffle; and when necessary, by a specially designed desuperheating enclosure before continuing its course through the heater. When sub-cooling is desired, the condensate is further guided through a sub-cooling zone before draining through the shell outlet.

Not only the steam in the shell, but also the water in the tubes is under constant control. Leak-tight tube joints and properly designed gasket joints throughout insure the safe routing of the water through the tubes.

Write for bulletin describing these control measures in detail. It also gives many other reasons why G-R Feedwater Heaters should be your choice, whether for low, medium or high-pressure service.

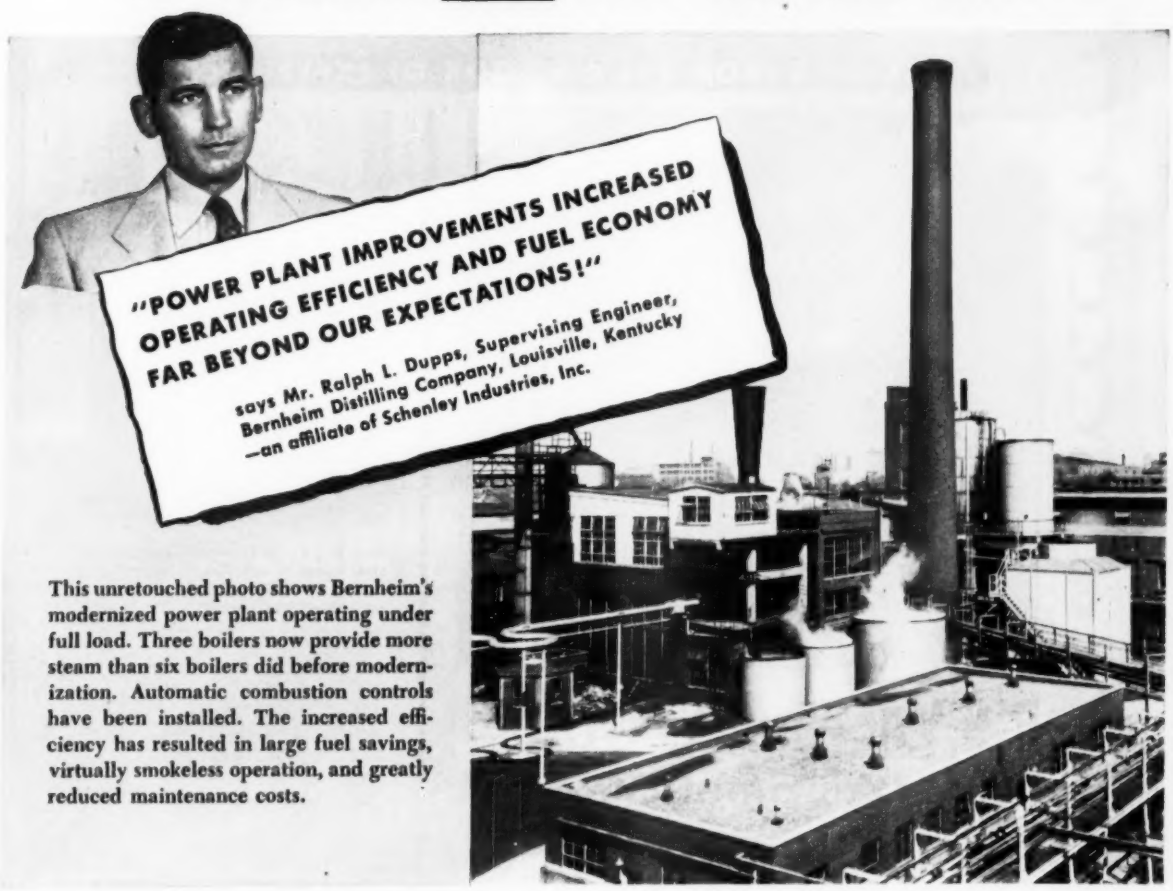
THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

G-R HEAT TRANSFER APPARATUS **Feedwater Heaters**

GR 318

For more data circle 519 on Post Card

"WE CUT OPERATING COSTS $67,000 A YEAR— BY BURNING COAL THE MODERN WAY!"


"POWER PLANT IMPROVEMENTS INCREASED OPERATING EFFICIENCY AND FUEL ECONOMY FAR BEYOND OUR EXPECTATIONS!"
says Mr. Ralph L. Dupps, Supervising Engineer, Bernheim Distilling Company, Louisville, Kentucky —an affiliate of Schenley Industries, Inc.

This unretouched photo shows Bernheim's modernized power plant operating under full load. Three boilers now provide more steam than six boilers did before modernization. Automatic combustion controls have been installed. The increased efficiency has resulted in large fuel savings, virtually smokeless operation, and greatly reduced maintenance costs.

Why not take *full* advantage of coal's economy? Cut your operating costs to a minimum with automatic coal- and ash-handling equipment. Get more steam for every dollar with an up-to-date combustion installation.

Whether you're building a new plant, or planning to modernize, a consulting engineer can show you how you can get big savings by burning coal in a modern plant designed to meet your *specific* needs.

Consider, too, that of all fuels, coal alone has virtually unlimited reserves. And America's coal industry leads the world in efficient, economical production. That means that, unlike other fuels, ample coal will be available in the future—and at relatively more stable prices.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

BITUMINOUS COAL INSTITUTE

A Department of National Coal Association, Washington, D. C.

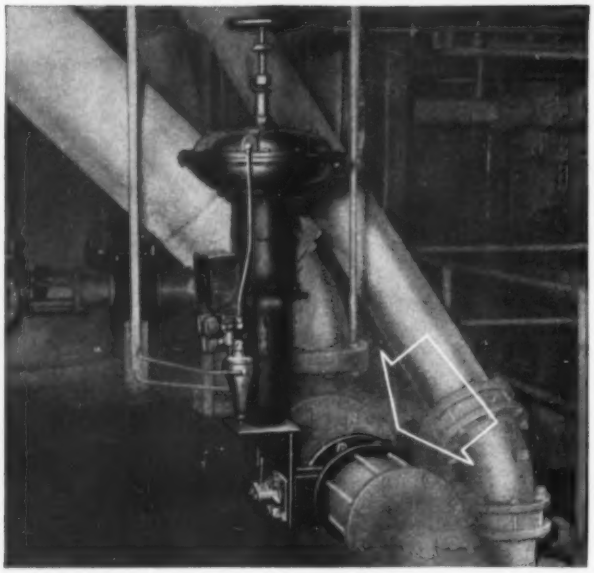
FOR HIGH EFFICIENCY FOR LOW COST

YOU CAN COUNT ON COAL!

For more data circle 510 on Post Card

R-S valveEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •

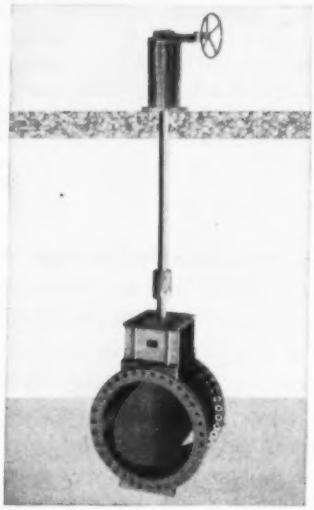


No. 677-A—1500-pound welding-end steel valve for superheated steam service. A. S. M. E. standards with heavy duty handwheel control.

R-S VALVE ADVANTAGES
Under Automatic Control

1. Wide range of throttling from open to closed position. 30 to 1 is standard. Minimum torque required for positioning.
2. Any type of instrument or control actuator can be used depending on preference and conditions. In any application, the R-S Valve usually costs less to purchase, less to install and results in lower pumping costs due to simplicity of design.
3. R-S Valve design offers no pockets to capture sediment, no change of flow-direction to create turbulence. Freedom from turbulence reduces erosion and cavitation and therefore adds to the life of the valve.

R-S Valves are used for regulation, pressure reduction, liquid level control, flow control, shut-off and other functional applications.



No. 864—30-pound valve equipped with rubber seat, extended shaft, thrust bearing, floor stand and heavy duty handwheel control.

Consult your local R-S Valve Engineers, or write direct.

R-S PRODUCTS CORPORATION • 4600 Germantown Ave., Philadelphia 44, Pa.

An S. Morgan Smith Company Subsidiary

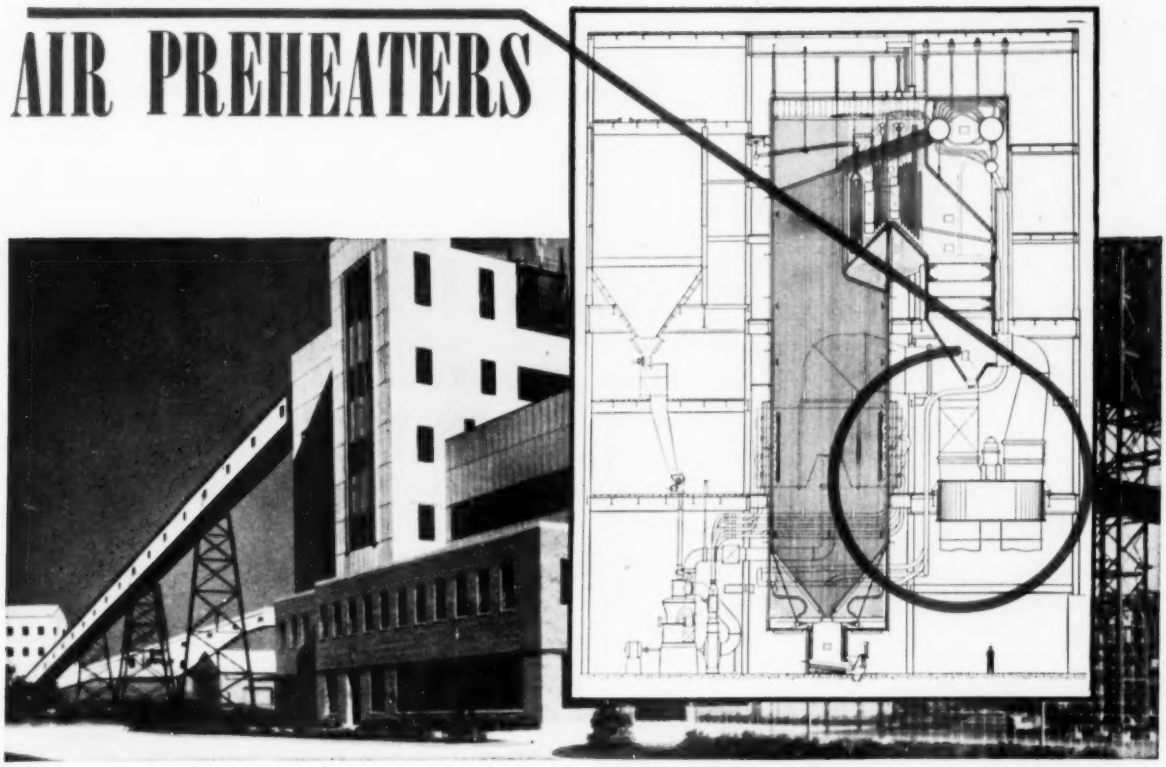
REPRESENTATIVES IN PRINCIPAL CITIES

For more data circle 511 on Post Card

All Boilers at New Plant Yates of the Georgia Power Company

equipped with

LJUNGSTROM AIR PREHEATERS



Geared to provide increasing facilities to keep pace with Georgia's growing power demands, Georgia Power Company's new Plant Yates Station is now producing 200,000 kilowatts with a third 100,000 kilowatt unit scheduled to go in service this fall. The station was designed and engineered by Southern Services, Inc., of Birmingham.

Each 100,000-kw turbine-generator in this new plant is powered by a Combustion Engineering—Superheater Steam Generator, designed for pulverized coal firing, and natural gas as an alternate fuel. Each C-E Boiler generates 975,000 pounds of steam per hour at 1325 psi and 950 F.

All of these modern steam generating units have been designed to incorporate two Ljungstrom Air Preheaters. These Ljungstroms are designed to preheat incoming combustion air to 655 F, and cool stack gases to 300 F.

Plant Yates is another example of the widespread acceptance of the Ljungstrom Air Preheater — by boiler manufacturers, consulting engineers, and utilities. Since the war, over 285,000,000 pounds of steam capacity per hour have been designed to incorporate the Ljungstrom . . . another proof that Ljungstrom Air Preheaters are standard equipment for high efficiency steam generating units.

THE Air Preheater Corporation 60 East 42nd St., New York 17, N. Y.

For more data circle 512 on Post Card

MOVE IN STEAM

NO BRICKWORK — NO EXCAVATION — NO FOUNDATION

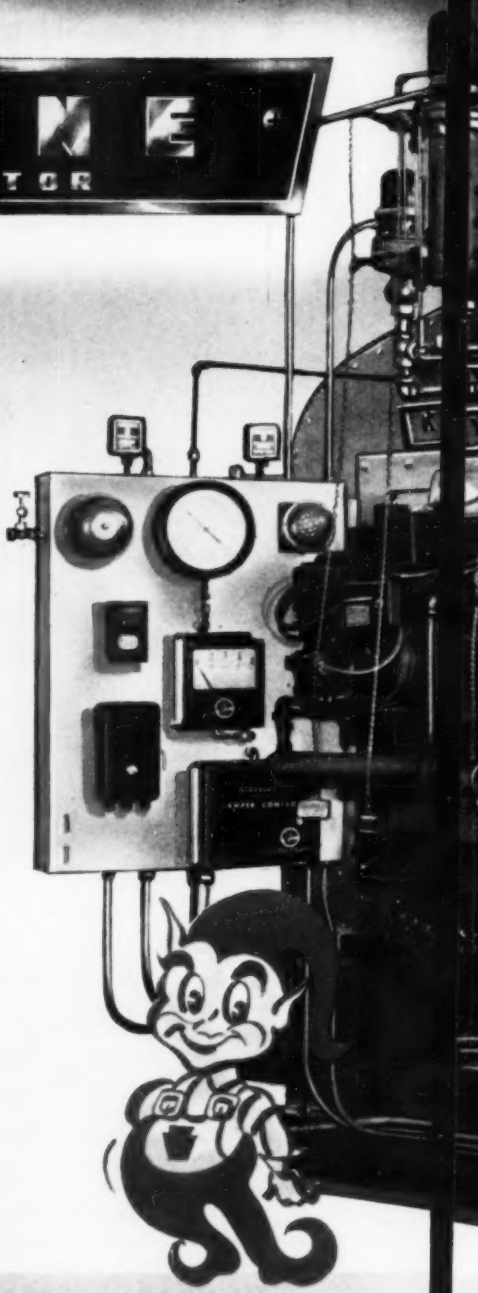
ERIE CITY

KEYSTONE

STEAM GENERATOR

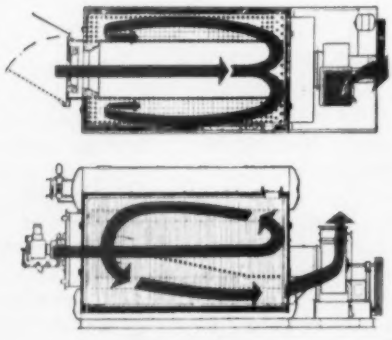
JUST HOOK'ER UP TO SERVICES

It's a compact, 2 drum *water tube* boiler heavily insulated and steel cased, complete with automatic oil or gas or combination burner. It has integral water cooled furnace. Keystones are available in standard capacities from 2490 lb. steam per hour and up as factory assembled units in a wide range of operating pressures. At the left is shown the bare boiler element to illustrate that Keystones are not ordinary packaged boilers. They are rated 5 square feet of heating surface per developed horsepower like largest water tube boilers.



UNIQUE 3 PASS GAS TRAVEL

Gas flow areas are proportioned to decreasing gas temperatures providing practically constant velocity and assure no pockets where unburned gases can accumulate. All boiler surfaces exposed to heat transfer are completely submerged below water line. Booklet SB38 tells the complete story.

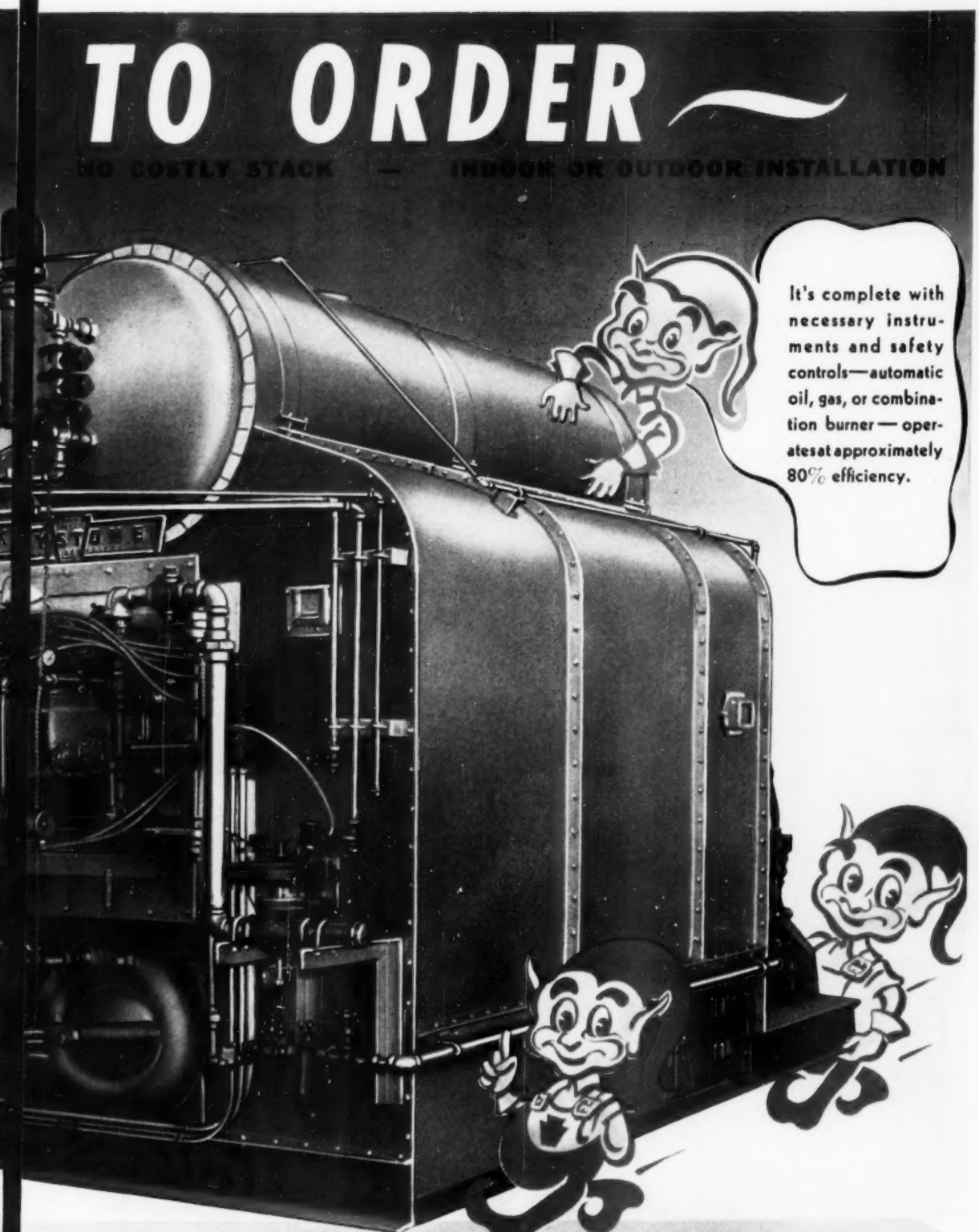


ERIE CITY IRON WORKS • ERIE, PA.

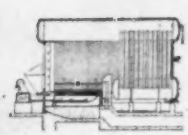
STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED and SPREADER STOKERS • PULVERIZERS

TO ORDER

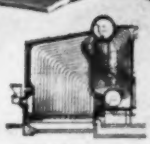
NO COSTLY STACK — INDOOR OR OUTDOOR INSTALLATION



It's complete with necessary instruments and safety controls—automatic oil, gas, or combination burner — operates at approximately 80% efficiency.



ERIE CITY VL
horizontal 2-drum integral furnace, steel cased steam generators.

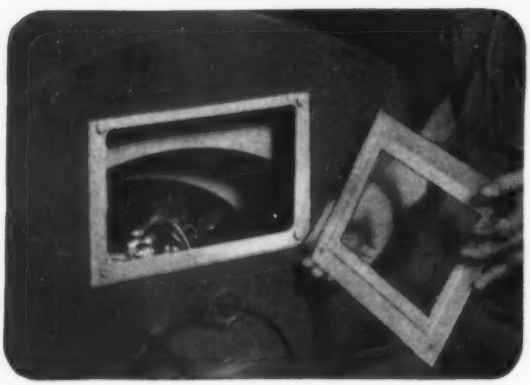


ERIE CITY VC
vertical 2-drum integral furnace, steel cased steam generators.

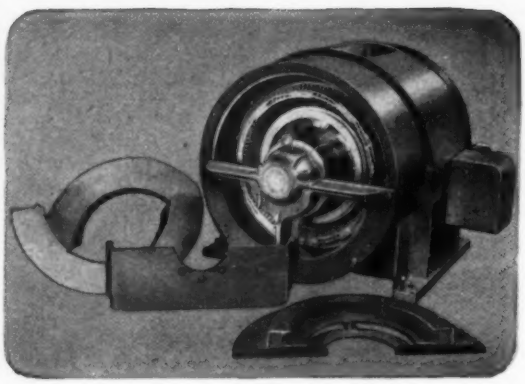
ERIE CITY TYPE "C"
3-drum steam generators.

For more data circle 513 on Post Card

Below is a typical forced-ventilated installation. Motor can be arranged so ducts can be brought in at any angle.



Lucite window makes brush inspection easy. Simply remove window for quick entrance to brushes . . . for checking and inspection and maintenance.



Light, sturdy end covers and air shields are easily and quickly removed for inspection and cleaning. No crane is required. One man can do the job easily.

MORE POWER PER DOLLAR

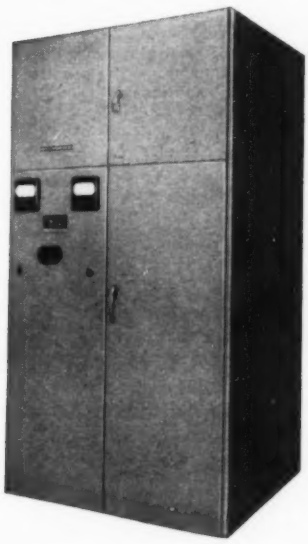
Synchronous Motor Offers New Installation Flexibility

When forced ventilation is required you can eliminate many installation problems with this synchronous motor. Air is supplied to the motor from both ends through air inlet brackets . . . two at each end, on either side. Duct or pipe connections can be brought from above . . . from below . . . from one side or the other . . . or a combination. Thus, you can position the motor without regard for duct work.

Covers and air shields, too, add to installation flexibility. They can be easily removed — by hand — for inspection or cleaning of the motor. No crane is required. Thus motors can be mounted in hard-to-reach places.

This added installation flexibility may open up new opportunities to save money with synchronous motors. In many cases, these motors will improve your power factor and reduce your power bill. They provide more power per dollar for many types of drives than any other motor.

Get all the facts on Westinghouse Synchronous Motor savings. Ask your Westinghouse representative for information on the simplified inspection and servicing these motors offer. Complete information is available. Ask him for a copy of DB-3200 or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10354-A

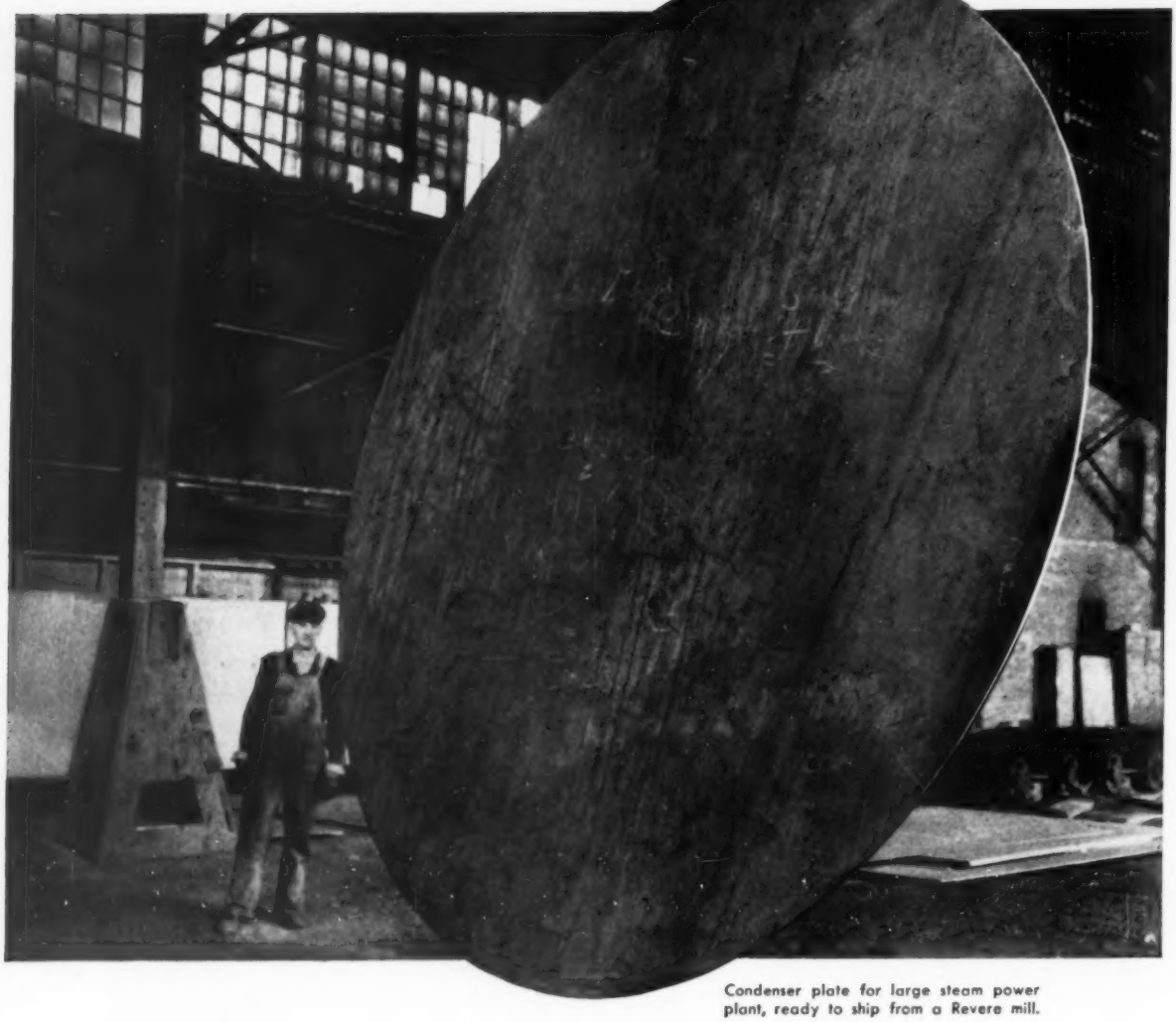


YOU CAN BE SURE...IF IT'S Westinghouse

Matched control for the motor. This Slipsyn Synchronous Motor Control protects your motor investment . . . helps you get more for your power dollar.

For more data circle 514 on Post Card

For Condenser Plates and Tubes... it's REVERE



Condenser plate for large steam power plant, ready to ship from a Revere mill.

In 1808 Paul Revere rolled the copper plates for the boilers of Robert Fulton's second and third steamships. Ever since then Revere has been a preferred source of supply for rolled non-ferrous plates. Today you will find Revere plates in marine and stationary condensers, heat exchangers, evaporators, feed water heaters and similar equipment in ships, chemical plants and refineries, public and private generating stations—wherever long service is essential.

Revere plates, like Revere condenser tubes, are available in all the customary alloys, shapes and sizes. For collaboration in selection of the most durable alloy, consult Revere.

And write on your company letterhead for a free copy of a most informative booklet: "Life Extension for Condenser Tubes."

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

For more data circle 515 on Post Card

CONO CONTROL VALVES . . . for water treatment

SPECIFIED BY THESE FIRMS
(partial list)

American Cyanamid—Ion Exchange Div.
Belco Industrial Equipment Div., Inc.
Cochrane Corporation
General Filters, Inc.
Graver Water Conditioning Co.
Illinois Water Treatment Co.
Permutit Co.
Worthington Pump & Machinery Corp.

INSTALLED IN THESE PLANTS
(partial list)

Atomic Energy Commission	Arco, Idaho
J. T. Baker Chemical Co.	Phillipsburg, N. J.
Blockson Chemical Co.	Joliet, Illinois
Consolidated Edison Corp.	New York
Dow Chemical Co.	Freeport, Texas
Dow Chemical Co.	Velasco, Texas
Dow Chemical Co.	Pittsburg, Calif.
Gulf States Utilities	Baton Rouge, La.
Johns-Manville	Manville, N. J.
Penna. Power & Light	Shawmont, Pa.
Philadelphia Electric Co.	Schuylkill Station

Cono Control

Cono Close Coupled Pneumatic Control Valves provide unbroken service day in, day out—year in, year out—in the automatic operation of demineralizers and other process systems. Hundreds of Conoflow valves, like those shown here, have been in operation many years without maintenance or repair. Cono Control Valves are available in assemblies for on-off service (guaranteed bubble-tight shut off) or for throttling control. Available with optional features such as handwheel type limit stops as shown, plastic position indicators, and micro-switch attachments for actuating remote visible or audible signals. Body sizes up to 12" in all materials—rubber lined, Saran lined, alloys, etc.

Write or phone for Conoflow's usual personalized attention.

CONOFLOW CORPORATION

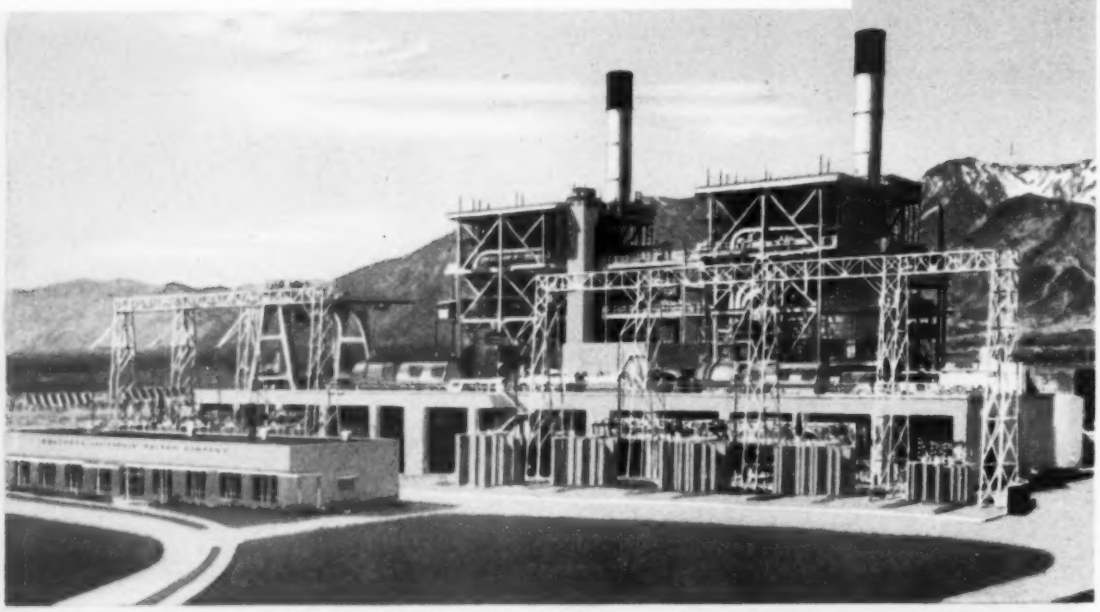
Foremost Manufacturers of Final Control Elements

2100 ARCH STREET, PHILADELPHIA 3, PENNSYLVANIA

For more data circle 516 on Post Card

ETIWANDA

Economical as all Outdoors



Etiwanda Steam Station of Southern California Edison Company, located in the fast-growing Fontana District near Los Angeles, has an initial capacity of 250,000 kw. It was designed and built by Stone & Webster Engineering Corporation, in collaboration with the client's engineering department.

Etiwanda Steam Power Station was designed for efficiency, ruggedness, simplicity — and economy.

The station, largest in the country to use cooling towers for circulating water, is almost entirely "outdoors". This and other features of the design have achieved outstanding economy in plant cost combined with high thermal efficiency and minimum operating costs.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

For more data circle 517 on Post Card

Holdtite® Friction Tape is the tops for general use. Has a high-strength fabric that makes it superior and dependable tape. High dielectric strength and strong adhesion. Straight-tearing, non-ravelling, contains no pin holes. Exceeds A.S.T.M. specifications.

Holdtite Rubber Tape is unbeatable for perfect splicing when used with U.S. Holdtite Friction Tape. Exceeds A.S.T.M. specifications.

Royalastic Plastic Tape is highly resistant to water, oils, acids, alkalies and corrosive chemicals. It does the work of both rubber and friction tape for a wide range of jobs. High dielectric strength. High tensile strength. Clings tightly. Good stretch. Makes neat splices.

Handy guide to the right U. S. tape for any splicing job

U.S. Gray Perfection Friction Tape has the strongest type of adhesion with a firm tack. A stronger, heavier, high tensile strength fabric. No pinholes. Will not dry out. Meets and exceeds all accepted specifications. Recommended for the most exacting jobs.

Usco Splicing Compound. The new (not reclaim) finest grade natural rubber used in USCO insures perfect and waterproof splices. It gives longer life — greater mechanical strength — better insulation. Will fuse into a solid mass quickly without heat.

Uskorona Splicing Compound gives 100% protection on high-voltage jobs. Maximum resistance to both ozone *and* moisture. Ideal for underground use. High tensile strength, elongation, extremely high dielectric strength, low power factor. Fuses quickly without heat or pressure, makes perfect splices.

United States Rubber Company is a single source for every electrical tape. Simplify your purchasing by using *one* line. Place your order now.

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RING BALANCE
INSTRUMENTS

and HAGAN
AUTOMATIC COMBUSTION
CONTROLS

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VERSATILITY

Hagan Ring Balance Instruments and Hagan Automatic Control units are the most versatile machines available for equivalent service today. Whatever your requirements may be, Hagan equipment can be selected to fit exactly your measuring, controlling, and recording or integrating problems.

DEPENDABILITY

An outstanding feature of Hagan Ring Balance Instruments and Hagan Automatic Controls has always been consistent dependability with reliable performance throughout a long life, and with minimum maintenance costs.

ACCURACY

Maximum accuracy is designed and built into every Hagan Ring Balance Instrument and Hagan Automatic Control unit. This assures high operating efficiency for your plant, and savings which usually amount to many times the cost of the equipment.

Whatever your control or instrumentation problems, let Hagan engineers help you solve them. Their experience, gathered from thousands of successful installations, is at your service.

Hagan Corporation

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

BOILER COMBUSTION CONTROL SYSTEMS
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METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND
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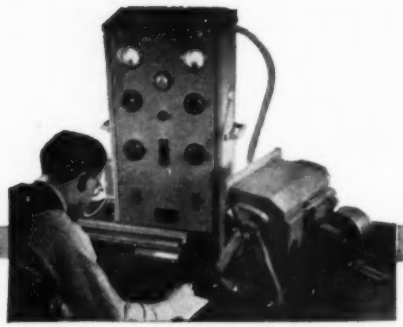
CAN PROFITABLY USE THE *Nalco* SYSTEM



X-Ray equipment, used in the Nalco Laboratories as an aid toward providing positive water treatment results.

● ***Water treatment service for small plants is an important part of Nalco's business.***

This indicates two things:

Small plants find Nalco Service Agreements a profitable investment . . . And

Nalco facilities and services are geared to handle — efficiently and economically — the needs of *any* plant, regardless of its size or the volume of water treatment chemicals used.

If your plant is a small one, you can get the same security from water treatment difficulties as many of the world's largest steam generating stations have with Nalco Service Agreements — and at a cost entirely in line with the size of *your* plant and your problems. Write today for complete details, or call your Nalco Representative.

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago 38, Illinois

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THE *Nalco* SYSTEM...Serving Industry through Practical Applied Science

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Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. Circle item numbers of all catalogs wanted on the postage-free card below, detach and mail

PUMPS, PUMPING

101 Screw Pumps — Now available are two new bulletins on this company's Warren-Quimby screw pumps. Twelve-pp Bulletin S-205 is devoted to standard gear-in-head, high-pressure long body gear-in-head and standard vertical gear-in-head types. Basic construction and design are discussed and sectional views indicate features. Dimensions and specifications are included. Six-pp Bulletin S-206 gives comparable information on double external bearing and hopper types. Warren Steam Pump Co., Inc.

102 Controlled Volume Pumps — Motor-driven controlled volume pumps are fully described in 40-pp Bulletin 553. Provides information on design and construction of the pumps, and includes capacity-pressure selection tables, types of capacity adjustments, standard and special designs and packaged systems. A chart shows typical applications in six major industries, and another chart, in full color, shows construction materials suited for use with some 170 industrial fluids. Milton Roy Co.

103 High Vacuum Pumps — Catalog 750, 36 pp, on company's Mirovac pumps for high vacuum, provides tables of formulas, constants and conversions frequently used in vacuum processing; information on continuous oil purification and other maintenance procedures, and tips on pump selection for typical vacuum systems. Many installations are pictured. F. J. Stokes Machine Co.

104 End Suction Pump — Bulletin WQ-214 introduces company's new Type DF, an end-suction centrifugal pump with capacities to 1000 gpm and heads to 400 ft. Double-row thrust bearings, deep stuffing boxes and other design features are shown in cutaway illustration. Gives dimensions, specifications for these pumps; lists a wide range of fluids they are suited to handle. Warren Steam Pump Co., Inc.

VALVES, PIPING, HOSE

105 Lubricated Plug Valves — Form 180 is a 32-pp comprehensive catalog describing company's new line of lubricated plug valves of steel and semi-steel construction, for working pressures from 175 to 900 psi. Sectional views show design details and dimensions are included. A section of the book is devoted to such accessories as remote control devices, wrenches, locking devices, adaptors. Also provided is information on lubricating and servicing, a compilation of service pressure-temperature ratings and drilling templates for flanges. The Ohio Injector Co.

106 Bin Gates, Valves — Twenty-pp Bulletin 1252 covers manufacturer's line of gates and valves, including the Twistite double closure bin valve and the Moore bin gate. The latter, for heavy duty applications, consists of an apron belt which can be rolled away from the bin opening. Complete details and dimensions are also shown for slide gates, quadrant gates and other units. Stephens-Adamson Mfg. Co.

107 How Pressure Piping Is Made — A detailed description of how pressure piping is fabricated for industrial use is given in this 16-pp booklet. Pictures shop facilities and steps taken in producing prefabricated piping for power generation, refining, pipe line transmission, paper, steel and chemical industries. Illustrations show assemblies made from carbon and alloy piping, and the bending of large, heavy-wall pipe. Western Supply Div., The Lummus Co.

108 Flexible Metal Hose — Fifty-pp Catalog 200 is a generously illustrated book on company's Titeflex helically-wound flexible metal hose and Unitlex helically-corrugated flexible metal hose. Besides providing descriptive data and specifications on the hose, fittings and assemblies, gives ordering instructions covering these items as well as metal conduit and ferrules, bendable pipe, high- and low-frequency leads etc. An engineering data section provides charts showing frictional losses versus flow rates, tips on installation and maintenance of metal hose. Titeflex, Inc.

109 Dangers Under Pressure — This 8-pp safety booklet is intended to help hose users avoid accidents and get long, trouble free service from hose and couplings. Fully illustrated, points out potential hazards involved in the use of high pressure hose, and shows how to handle it. Also covers the proper selection and application of hose couplings. Hose Accessories Co.

110 Tips on Hose Care — This illustrated bulletin tells what to do and what not to do in the use and storage of various kinds of hose, including steam, fire, oil, gasoline, water, air, suction and sandblast. Also includes installation "do's and don'ts" and instructions for making a static bond. Hewitt Rubber Division, Hewitt-Robins Inc.

INSTRUMENTS AND CONTROLS

111 Care of Control Equipment — Eight-pp Bulletin 14X7612A, "Proper Maintenance of Control," tells what to look for in maintaining electrical control devices. Besides giving helpful suggestions on overcoming the most frequent difficulties booklet provides a control trouble-shooting chart for quick reference showing the symptom, possible cause and cure. Includes a list of 26 suggested checking points for preventive maintenance. Allis-Chalmers Mfg. Co.

112 For Measuring Vacuums — Catalog 7001, 32 pp, describes many types of pressure and vacuum gages used to measure vacuums up to 10–11 mm of mercury and pressures as high as 150,000 psi. Presenting information in tabular form, the catalog covers indicators, recorders, pneumatic and electric controllers and pneumatic transmission. Illustrations include diagrams of typical control systems. Auxiliary equipment is also presented. Industrial Div., Minneapolis-Honeywell Regulator Co.

AUGUST 1953
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POWER ENGINEERING

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113 Condensate Drainage Control — General Catalog 500, 16 pp, describes a condensate drainage control unit designed to combine functions of steam trap, air by-pass, check valve, strainer, sight glass, temperature indicator and control. Explains value of bimetal principal utilized, and the operation of the heat-pressure system. Other advantages of this universal trap and its application in various industries are discussed. Includes specifications. Velan Engineering Co.

ELECTRICAL

114 Motor Standards Compared — Eight-pp Bulletin GEA-5995, giving information on the new NEMA motor standards, compares old and new frame assignments for open-type poly-phase, single-phase and wound-rotor motors as well as totally-enclosed fan-cooled types. Also lists suggested new frame assignments for foot-mounted and flange-mounted motors and standards for minimum locked-rotor torque for general purpose single-phase motors. General Electric Co.

115 Motor-Generators — Bulletin 30-200, 6 pp, describes motor-generators from ¾ to 1500 kw. Shows 23 designs of a-c to d-c, a-c to a-c, d-c to d-c and d-c to a-c motor generators. Electrical specifications and applications are given. The Electric Products Co.

116 Across-the-Line Starters — Bulletin 14B7132A, 8 pp, describes company's Size 0-3 across-the-line motor starters, covering manual and magnetic types, and combination and reversing as well as push button control stations. Operating arrangements are described and three types of enclosures shown. A table shows motor voltage and motor maximum hp (three phase) applicable to sizes described. Allis-Chalmers Mfg. Co.

117 Variable Speed Motors — Sixteen-pp Bulletin 1797, revised, outlines many reasons why variable speed motors can be used to improve production, and it includes illustrations of all types of company's Varidrive motors, as well as their mechanical features, remote controls, etc. U. S. Electrical Motors Inc.

118 Miniature Selenium Rectifier Stacks — Illustrated Bulletin GEA-5935 contains data on applications, construction features, and electrical characteristics of the small selenium rectifiers. Includes tables of ratings and dimensions, plus graphs of the effect of temperature and life expectancy of the various types of stacks. General Electric Co.

The Reader Service Card below needs no postage. Just circle item numbers of all bulletins wanted, fill in name, company, detach and mail

119 Flexible Conduit — Bulletin UA-530 describes "Sealtite" liquid-tight electrical wiring conduit announced as UL approved for use in wet locations. Discusses ease of installation, provides specifications, suggested uses. American Metal Hose Branch, The American Brass Co.

120 Electrical Connectors — Twelve-pp Bulletin 3-4-1 covers manufacturer's Williamsgrip electrical connectors, giving details of their operation, performance, applications, and dimensions. Booklet is well illustrated with photos, schematics and graphs. AiResearch Mfg. Co.

HEATERS, HEAT EXCHANGERS

121 Heat Exchangers, Storage Heaters — Sixteen-pp Catalog 5 covers more than a dozen types of hot water storage heaters and heat exchangers, including horizontal and vertical hot water storage heaters, instantaneous water heaters, converters, condensate coolers. Tables assist in selecting correct equipment for given operating conditions and typical examples demonstrate use of the tables. Patterson-Kelley Co., Inc.

122 Combination-Fired Heaters — Bulletin 560-52 explains how combination oil- and gas-fired industrial space heaters were used for comfort heating and also to supply heat for process drying of vitreous ware. Tells how these heaters doubled a plant's output by decreasing drying time of castings and molds. Dravo Corp.

123 Unit Heaters — Sixteen-pp Catalog 403 contains description, photos, applications, specifications and optional features of a line of centrifugal fan type unit heaters. Diagrams of typical mounting arrangements show many ways these heaters can be used. Tables and charts give capacities. Airtherm Mfg. Co.

METALS

124 Copper and Corrosion — Information on corrosive attack on copper and copper alloys is presented in Publication B-36R, a new 28-pp revised edition of company's booklet, "Corrosion Resistance of Copper and Copper Alloys." Explains chemical and physical nature of corrosive attack in its various forms, and provides a tabulation showing the relative corrosion resistance of the principal types of copper and copper base alloys in contact with 183 corroding agents. Includes detailed information on stress-corrosion cracking, galvanic corrosion, fresh and salt water corrosion, and atmospheric corrosion. The American Brass Co.

125 Properties of Electrodeposited Nickel — Bulletin A-163 is an illustrated report on the uses of electrodeposited nickel, properties of deposits and variables that influence them, and composition and structure of deposits. It is of interest to users of nickel plating for electroformed shapes, building up worn machine components, and heavy industrial coatings for imparting nickel's corrosion resistance to common construction materials. The International Nickel Co., Inc.

MECHANICAL POWER TRANSMISSION

126 Gearmotors — The function, design and application of gearmotors are described in Bulletin GEA-1437H, 16 pp. Presents standard types of company's Tri-Clad gearmotors with ratings from ¼ to 200 hp. Cutaway photos show relative position of parts distinctive to the design of each motor. Adaptability to low-speed jobs and adjustable-speed drives are explained along with gearmotor maintenance. Electrical types and characteristics as well as special mechanical features are given. Also included is a table giving gearmotor applications, and selection factors. General Electric Co.

(Continued on page 137)

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ARE CLOGGED LINES LIKE THESE CUTTING YOUR WATER SUPPLY?

Over 1½ Miles of Buried Water Line Chemically Cleaned IN PLACE by Dowell Service

You don't have to dig up water lines in order to clean them! Take the case of a major railroad that had over 8600 feet of *buried* water lines, ranging from 2 to 12 inches in diameter. The capacity of these lines had been greatly reduced by scale deposits. Dowell Service used liquid solvents to clean all the lines, *in place*, during a period of only six days with a minimum interruption in service.

Dowell Service offers *fast*, effective chemical cleaning of pipelines of all kinds—water lines, disposal lines and product lines. And, whether these lines are underground or above, indoors or out, no digging or dismantling is necessary. Dowell solvents are designed to dissolve the accumulated deposits, and are introduced through regular connections. Because they are liquid, Dowell solvents reach wherever steam or water can flow, cleaning places inaccessible by other methods—angles, curves, valves, complicated surfaces and hook-ups. *Experienced* Dowell engineers do the job using Dowell-designed truck-mounted pumps, mixers and control equipment.

Many other types of equipment can also be cleaned chemically by Dowell. If you have boilers, condensers, evaporators, bubble towers, water wells or other operating equipment where deposits are reducing capacity, let Dowell Service *save you time and money in maintenance cleaning!*

FIND OUT ABOUT CHEMICAL CLEANING! There are many places in your plant where Dowell Service can clean equipment faster and better than out-dated mechanical methods. Call your nearest Dowell office for a fact-filled book. Or write direct to Tulsa, Dept. H-24.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED
Tulsa 1, Oklahoma

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A Service Subsidiary of
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Industries served by VU Boilers

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Industry Leaders Set the Pace with VU

Right down the line, in most every industry, you'll find the leading companies – as well as the smaller companies that may well be tomorrow's leaders – depending on C-E Vertical-Unit Boilers for dependable, low-cost steam.

Take Pulp and Paper Mills for example. Few industries use more steam or have a larger stake in the economy and reliability of their steam generating equipment. The list on the opposite page is just a small sample of the nationally-known leaders in the pulp and paper field that have Vertical-Unit Boilers in service at one or more mills.

Only larger companies are listed because here, as in any industry, the buying decisions of big companies are especially significant. Such companies have the breadth of experience, the diversified operating conditions and the organization necessary to explore and evaluate the merits of the equipment they need.

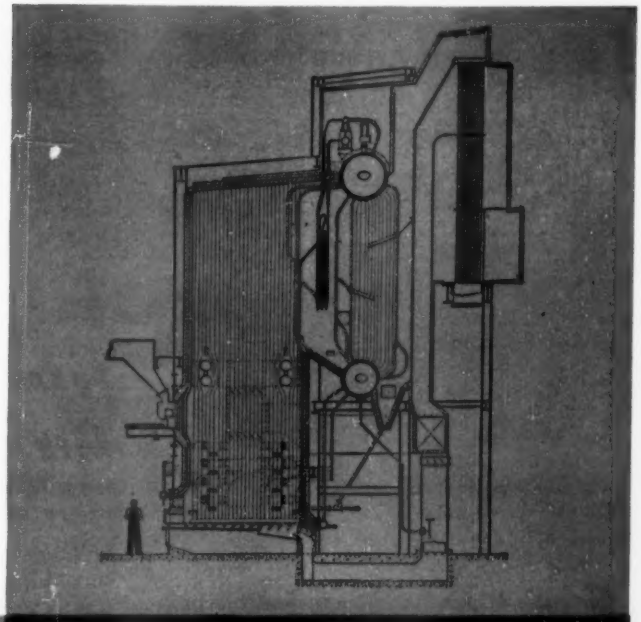
So, where you need boilers – in capacities from 10,000 to 350,000 pounds of steam per hour – take a tip from the leaders. Discover – as they have – the advanced design . . . sound construction . . . proved reliability of C-E Vertical-Unit Boilers.

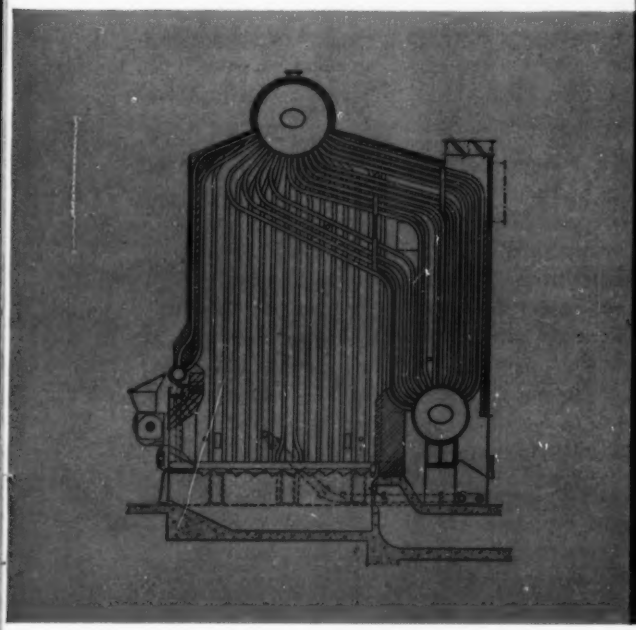
COMBUSTION

Leading Pulp and Paper Mills that have Purchased VU Units for One or more Plants

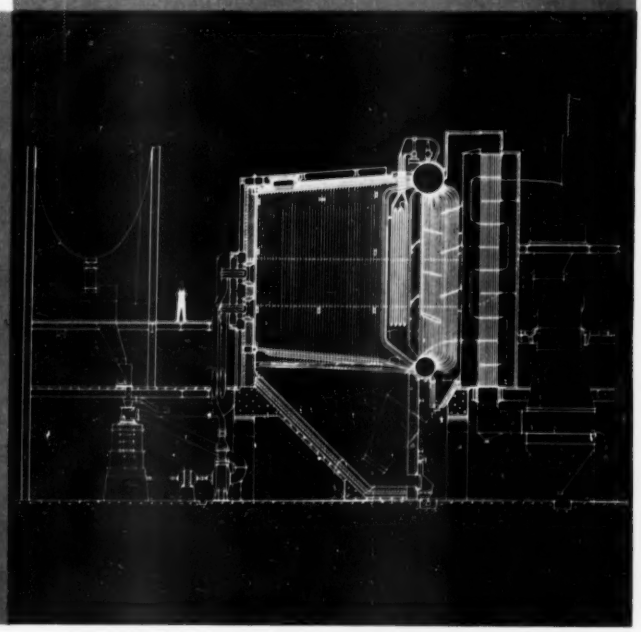
The Brown Company
Chesapeake Corporation
Container Corp. of America
Fraser Companies, Ltd.
Robert Gair Company, Inc.
International Paper Company
Kimberly-Clark Corporation
Macon Kraft Corporation
Marathon Paper Mills of Canada, Ltd.
National Container Corporation
St. Regis Paper Company
Scott Paper Company
S. D. Warren Company
Weyerhauser Timber Company

VU-50 Boiler — This unit, one of two duplicates, is installed at a West Coast mill. It is designed to burn hogged wood on a high-set spreader stoker. Capacity — 150,000 lb of steam per hr; operating pressure — 570 psi; steam temperature 675 F.





VU-10 Boiler, one of two in a Midwestern plant. Fired by coal, using a C-E Spreader Stoker. Capacity — 18,000 lb of steam per hr at 200 psi; no superheat. VU-10 capacities range from 10,000 to 60,000 lb of steam per hr.



VU-50 Boiler installed in a Southern mill. This boiler is fired with pulverized coal using C-E Raymond Bowl Mills. The capacity is 150,000 lb of steam per hr. Steam pressure is 865 psi — steam temperature is 825 F.

B-612

ENGINEERING, INC.

C-E

200 MADISON AVENUE, NEW YORK 16, N. Y.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

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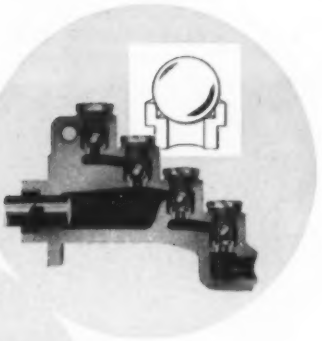
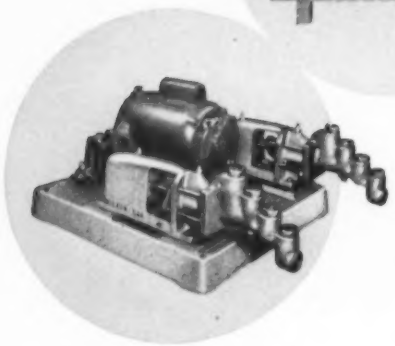


Basic design simplicity of the *exclusive* Milton Roy liquid end step-valve assures high and reproducible volumetric efficiency. The self-cleaning *double* ball-checks seat positively, dislodge any trapped particles by spinning action, are snap-acting.



Chemical Treatment Costs Drop with this Milton Roy Pump

CONTROLLED VOLUME PUMPING

INSTRUMENTATION

PROCESS CONTROL SYSTEMS

BLENDING AND FORMULATING

On The Job in a well-known chemical processing plant, this Milton Roy Motor-Driven Controlled Volume Pump meters the flow of concentrated sulphuric acid to the deoiling step in an ore flotation process. The accurate control of acid addition results in minimum usage of concentrated sulphuric acid and subsequent caustic, thereby lowering treatment costs.

This is a typical example of how Milton Roy Pumps effect dollar savings in hundreds of applications throughout industry. As motor-driven or air-powered units, or as components of automatic systems, their accuracy and long service life bring measurable returns to users. In *boiler feed water treatment,* for example, they are used in all forms of handling internal or external treating chemicals; in *petroleum processing,* for crude desalting and gasoline treating; in *textile manufacturing,* for acid, alkali or bleach baths; in *instrumentation,* to satisfy control requirements.

These are rugged, dependable pumps. They meter practically any liquid—abrasive slurries, solids in suspension, solvents—in capacities from 3 milliliters per *hour* to 45 gallons per *minute,* against pressures up to 25,000 pounds per square inch with instrument accuracy. We invite your inquiries.

Bulletin No. 553 tells you how you can profitably use Milton Roy Motor-Driven Controlled Volume Pumps in your business. Write for your free copy.

MILTON Roy COMPANY

Manufacturing Engineers • 1320 E. MERMAID LANE • PHILA. 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

Engineering Representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

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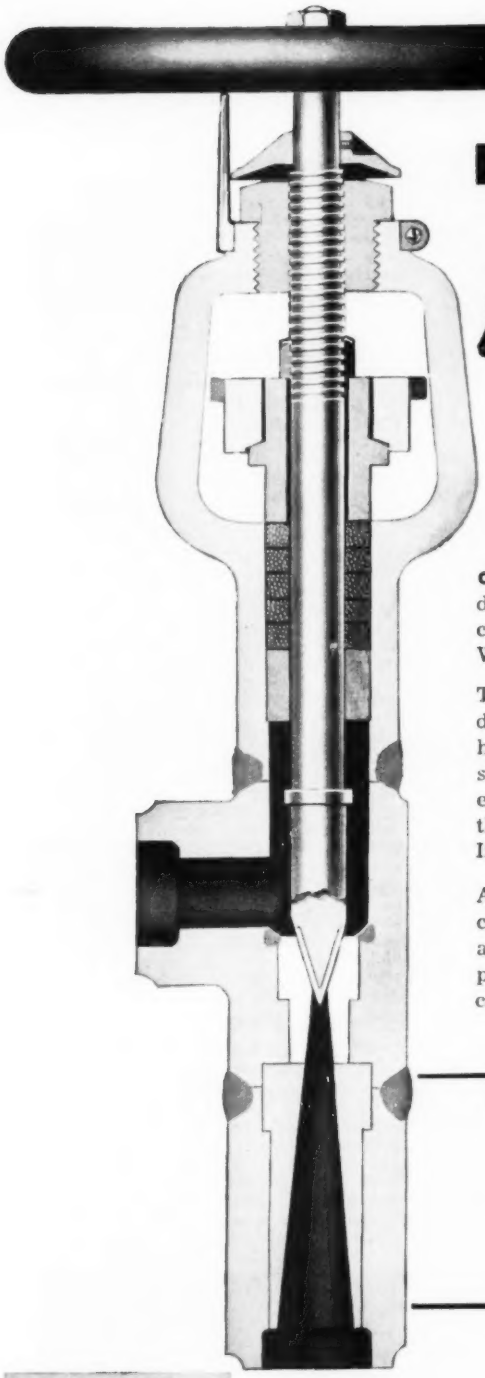

BUILT TO WITHSTAND *Flashing Steam...*

HANCOCK
HI-PRESSURE DROP
WELDVALVES

CONTINUOUS BLOWDOWN can wreck a conventional valve seat in a few days or weeks, regardless of pressure or temperature. Avoid the high cost of such quick destruction — specify Hancock Hi-Pressure Drop Weldvalves. They combine orifice, shut-off and index in a single unit.

The inlet of these blowdown valves is above the seat. The diverging delivery tube provides a rim for the flashing steam and compels the high-velocity stream of water to dissipate its force upon itself, instead of destroying the valve. This ingenious design assures long, economical life in continuous blowdown service. Because they are of the orifice type, you can use a smaller size valve with a large capacity. Intermediate capacities obtainable by adjusting the valve opening.

Ask for complete data on Hancock Hi-Pressure Drop Weldvalves for continuous blowdown systems. Also learn how these rugged valves are used on feed water pump bypass relief, in turbine washing processes, and in other services where corrosion is severe and conventional valves wear rapidly. Write or phone today.

HANCOCK HI-PRESSURE DROP WELDVALVES
NO BONNET JOINT DESIGN

Sizes: ¾", 1", 1½".
Orifice Sizes: Minimum ⅛" Maximum 1"
Pressures: 600 p.s.i. thru 2500 p.s.i.
Connections: Screwed or socket weld ends.
Seats: 500 Brinell Stainless Steel or Solid Stellite. Venturi throat silver brazed to the body.
Steam-Disc: Integral needle point—500 Brinell Stainless Steel or tipped with Stellite.

When Hancocks go in, valve costs go down.

HANCOCK VALVES

A product of **MANNING MAXWELL & MOORE, INC.** WATERTOWN 72, MASSACHUSETTS

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

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Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-free cards on pages 35 and 138 for your request. Just circle the numbers of the items you'd like to know more about

1 — FUSE LINKS

In two speeds; designed to meet new EEI-NEMA standards

These new fuse links are announced as electrically and mechanically interchangeable with other makes of EEI–NEMA standard fuse links, with assurance of uniform degrees of coordination between adjacent link sizes. Included in the new line are two speeds, "K" (fast) and "T" (slow) with time current characteristics to meet major operating requirements.

The links are offered in ratings from

1 through 200 amp with two different fusible section constructions — die cast and wire type. The button and shank of one of these links is a one-piece forging designed to eliminate additional joints through which current could flow. Company says this feature is a contributing factor to the low temperature operation of the links. Buttons and shanks are coated with tin to prevent corrosion and provide good contact surfaces. The links come in three-, four- or five-cell containers, as shown. Cartons of larger quantities of individual cells are also available. Line Material Co.

2—LEAK DETECTOR

Halogen sensitive, for easier detecting of leaks in closed systems

The new Type H-1 Detector is a redesigned version of an instrument introduced five years ago and declared capable of finding a leak so small that only 1/100 oz of gas will pass through the opening in a year. It is reported to have gained wide acceptance in testing for leaks in refrigerator and air conditioning systems, tanks, boilers, pipings and other equipment that must be leak proof and into which a halogen gas can be introduced as a tracer.

In the new Type H-1, a loudspeaker has been built into the control unit for audible indication of leaks, and an automatic balancing circuit is incorporated to compensate for changes in background air contamination. And in the control unit is a new light-weight internal voltage stabilizer. The former model required an external voltage stabilizer.

The new detector retains several features of the former model, including earphone plug and instrument indication of leaks. Now, however, leak indication can be simultaneously indicated by means of the dial, earphone attachment or loudspeaker. The equipment consists of a pistol-like sniffer and a 17-lb control box. General Electric Co.

3 — SHAFT SEAL

Incorporates multi-contact arrangement for long contact life

The Red Seal consists of a standard gear reduction which reduces the speed of each contact disc to $\frac{1}{10}$ that of the main shaft. And, in addition to the positive speed geared discs, there are intermediate floating contact discs that theoretically reduce speed between geared discs by 50 per cent. Since the stationary contact member is supported by a metallic diaphragm, all contact members are flexible, it is explained, and shaft vibrations do not affect contact life.

Several other features are announced as contributing to the efficiency of the Red Seal for pump sealing. Due to its all-metallic construction there are no temperature limits, company points

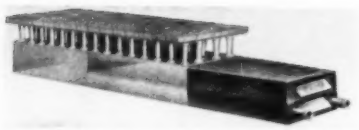
out, and the elliptical shape of its housing and other supporting features make it suitable for extreme pressures. The seal mechanism can be operated in oil bath and be completely independent of the fluid being pumped. The seal is said to be easily installed, and the shaft sleeve wall is thick enough to bore for many shaft sizes. Three stock sizes are available covering shafts from $\frac{7}{8}$ to $2\frac{1}{4}$ in. International Industries, Inc.

4 — GAS BURNER

In stock sizes from 450,000 Btu input upward to 11,520,000 Btu

This multiple section upshot burner is installed through the ash pit door. Numerous possible combinations of burner heads make it possible to apply the burner for the most effective use of the fire box area, and individual venturi mixing tubes for each burner head provide for uniform mixture to all parts of the burning area. Primary air entrainment is high, company points out, with adjustment provided for various types of fuel gas.

No refractory combustion chamber liner is used. All heat is transferred



immediately to the furnace or boiler. A metal plate set flush with the burner heads acts to keep heat from reaching the boiler base and reduces boiler room temperature by eliminating escape of heat through the floor. When recommended controls are used, the burner is step-acting and modulated so its various sections come on in sequence. Petro.

5—FLOW METER

Variable area type, now furnished with pneumatic transmission

The Linameter is fundamentally linear and the air output signal varies directly with the rate of flow. It is an all metal instrument operating on the rotameter principle. Mounted directly in the pipe line like a valve, it is suitable for measuring rates of flow of liquids, vapors or gages from 0.3 to 3 gpm to as much as 120 to 1200 gpm. Corresponding gas or steam flows depend on pressure and temperature conditions.

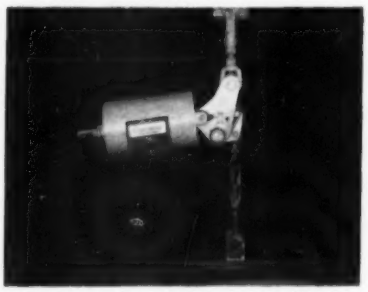
The instrument has a metering float which rides vertically up and down in a tapered metal metering throat inside the meter body. The connection between the metering flat inside the flow stream and the instrument components outside is magnetic and said to be frictionless. The Linameter is especially suggested for measuring flow rates of those fluids which cannot be conveniently handled by differential pressure type instruments. It is declared suitable for hazardous areas because it is explosion proof and needs no electrical power, and is said to be an ideal flow transmitter for use with pneumatic receiver type recorders, controllers and indicators. It is available in sizes from 2 to 8 in. Catalog 650 gives full details. Penn Industrial Instrument Corp.

6 — PIPE HANGER

For high temperature piping systems, is available in 16 frame sizes

The Counterpoise Pipe Hanger is described as a spring-actuated counterbalance which, through its system of linkage, transforms the varying force of the spring in an accurate mathematical ratio to produce a load supporting effort of constant value through the entire range of travel as the pipe expands or contracts with temperature changes.

As shown in the photo, the flexible top



connection of the hanger assembly lets it fall in line with the direction of load pull, so that horizontal travel of the piping has no appreciable effect on the hanger operation. The unit may be positioned at any angle it is noted.

Modern approach to better power piping

CRANE
Pressure-Seal Bonnet
VALVES

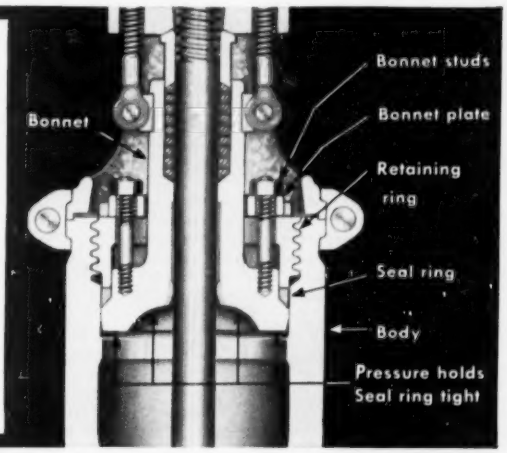
DROP A CARD TODAY—Ask for this new 16-page catalog and get acquainted with steel valve design that more than meets the rigid requirements of today's high-pressure, high-temperature power plant service. See how modern, proved Crane Pressure-Seal design makes possible a simpler, more compact valve of greater safety and dependability with—

NO BONNET-JOINT LEAKAGE
NO BONNET-JOINT MAINTENANCE

The line includes 600, 900 and 1500-Pound Gates, 1500-Pound Globe and Angles, 900 and 1500-Pound Stop-Checks. Sizes 1-inch up to 24-inch. Butt-Welding, Socket-Welding or Flanged ends, depending on valve type. Crane also invites your inquiry for unusual valve requirements.

HOW CRANE PRESSURE-SEAL DESIGN WORKS

Why fight line pressure when you can *use it*—a good question that Crane successfully answers with the revolutionary Pressure-Seal Bonnet Joint. For line pressure is actually harnessed to keep the bonnet joint tight against leakage—and free from maintenance. As shown in the section to the right, the bonnet joint is inside the valve, and the sealing element is a wedge-shaped seal ring. Internal fluid pressure, acting upon the entire underside of the bonnet, forces the bonnet against the seal ring; this wedges the seal ring between the body and bonnet, forming a pressure-tight metal-to-metal joint. Thus maintenance of the joint is minimized, although the assembly is readily dismantled for inspection and just as readily reassembled.



Companion line *Lip-Seal Bonnet* Globe and Angle Valves bring same advantages in sizes ½ to 2-inch—No bonnet-joint leakage, no bonnet-joint maintenance, better all-around serviceability. Ask for Circular AD1902.

THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

For more data circle 527 on Post Card

In this hanger all principal load carrying parts are concentrated at one end, permitting flexibility of installation and saving space in congested areas. The overhanging assembly can also be revolved at any angle about the load and support rods, it is noted. Sixteen frame sizes offer load capacities from 200 to 16,000 lb and expansion travels to 12 in. Operational data on this is given in Bulletin 153. National Valve & Mfg. Co.

7—RELAYS

General purpose, offer longer life, also greater flexibility of use

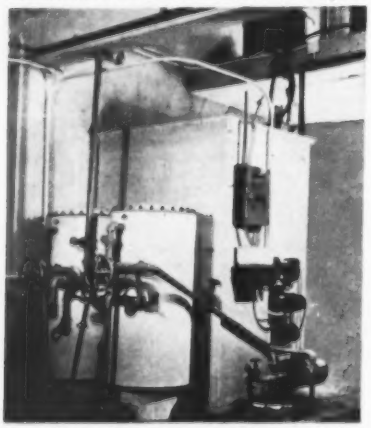
According to manufacturer, the operating life of the new CR2790-E Relays has been greatly extended by the use of a braided shunt and repositioning of the shunt to reduce tension and wear. Use of the standardized open-form relays with conversion kits, which may be stocked separately, provides the units with greater utility and permits reduction in inventory, it is pointed out. Conversion units are available for metal and compound base back-mounting, base receptacle and relay jack-plug applications, and explosion-proof enclosures for dust tight and Class I, Group D service.

The relays are rated from 6 to 300 v; 60, 50, and 25 cycles plus d-c; and 10 amp continuous contact rating. Arrangements include double-pole single-throw, double-pole double-throw, and single-throw double-break. The relays may be used as starters for small a-c motors have sufficient overload protection, and are suggested for use in electronic and air conditioners, where small space and long life are factors. Further details are given in Bulletin GEC-257C. General Electric Co.

8 — WATER CONDITIONER

Is integrated water conditioning plant, available in eight sizes

According to manufacturer of these packaged units they may be used, without alterations: to remove turbidity, color and organic matter from water supplies; to chlorinate; to remove bad tastes and odors; to remove iron and manganese; to neutralize; to soften, and to de-alkalize. The plants may be used to condition water for small municipali-



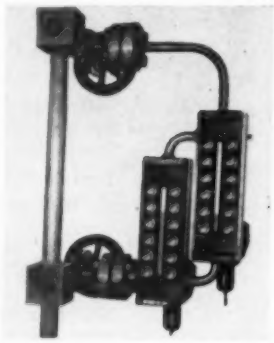
ties, factories, power stations, boiler plants, mills and food processing plants.

Each water conditioner consists of company's Precipitator with a built-in clearwell, a proportioning chemical feeder control, a coagulant feeder tank, a lime or soda ash and hypochlorite feeder tank, an inlet float control valve, company's Neutralite filter and Carbo-Dur purifier units, and a service pump. They come in eight standard sizes from 500 to 3300 gph and flows of 12,000 to 79,000 gal per 24 hr. Larger capacities can be furnished. The Permutit Co.

9—FLAT GLASS GAGES

In new separated design, for improved boiler water gage service

Greater dependability, longer gage line and more accurate water level readings



in high pressure service are claimed for this new separated-design water gage assembly. The gage glass inserts are pressure-sealed "floating assembly" type and the gage valves are company's Welbonds.

On gages for wide range of visibility greater flexibility is gained by using two independent inserts, and by interconnecting expansion loops. On gages for medium ranges, using one insert, a single expansion loop is used. The lower flanged connection and upper flanged loop connection result in the elimination of stuffing boxes. And the short lower flanged connection eliminates the cold water leg, resulting in greater accuracy in level reading, it is noted. Tie-bar-type water column linking the gage valves provides circulation to keep gage nearer drum temperature. Yarnall-Waring Co.

10—SWITCH CONTROLS

Conveyor activated, automatically regulate production operations

Two mechanisms long used on this company's liquid dust control systems to start and stop spray nozzles employed in treating materials, such as coal, carried on conveyor belts, are now available to general industry. Both controls are conveyor activated and adaptable to any handling system for activating signal lights, auxiliary conveyors or other controls.

The Model UB is designed for operation and installation under the belt, and is said to be especially useful with belts conveying coarse, abrasive or lump material. This control is mounted beneath the belt on a spring loaded shaft which exerts light tension on the shaft arm and the master wheel rolling against the belt. A deflection of as little as 1/16 in. on the belt actuates the limit switch arm.

The Model 4A is installed over the conveyor belt, opening and closing the switch control by a paddle arm. This type of control is recommended primarily for fine, lightweight materials which would not deflect the belt, or for use on chutes, pan and roller conveyors. Johnson-March Corp.

11 — NEW IMPROVED SOLVENT

Is announced as non-flammable, efficient, and safe to use

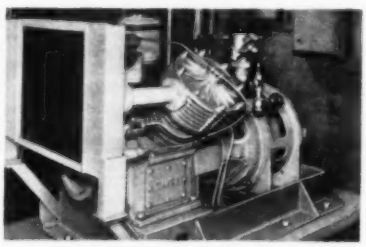
Penolene 643 is said to retain all desirable qualities of carbon tetrachloride — non-flammability, quick drying time and powerful solvent action — while reducing the toxic hazard to an all-time low. Vapor inhalation tests on monkeys are reported to show it only slightly more toxic than kerosene. And company says it will not cause a toxic build-up within the body. Penolene 643 is suggested for a wide range of cleaning jobs and as a diluent. It won't leave a film or residue on surfaces cleaned, it is claimed, and will not damage electrical insulation or electronic parts. Test data and sample are available. The Penetone Co.

12 — AIR COMPRESSOR

Is new 25-hp stationary unit for general industrial applications

The Model 25D has a displacement of 128 cfm, is direct connected to a 25-hp electric motor, and available with constant speed or start-and-stop pushbutton controls. This compressor is of V-type design with one 7 3/8 in. low pressure cylinder and one 4 3/8 in. high pressure cylinder. The stroke is 4 1/2 in.

The unit is furnished ready for mounting on sub-base, and standard equipment includes intercooler with safety



valve, air cleaners, air pressure regulator and unloaders, motor starter and controls. Davey Compressor Co.

13—NEW TYPE FILTER

Is designed for making raw water safe for industrial plant use

A surface type diatomite filter, the Model SCJ is suited for large volume water filtering, according to manufacturer, and makes practical the use of lakes, rivers and wells for plant water supply. Company says it has been demonstrating its effectiveness and economy in municipal water works and swimming pool installations for about two years. Laboratory tests are reported to show that this filter completely removes suspended matter, colloidal or solid, and removes 80 to 100 per cent of bacteria, depending on the type of bacteria and the grade of diatomite used — thus reducing the required chlorination to a low point. Filters are available in sizes from 25 to 1000 sq ft of filtering surface. Sparkler Mfg. Co.

Want more details on these new products? Just circle the item numbers on post cards on pages 35 and 138

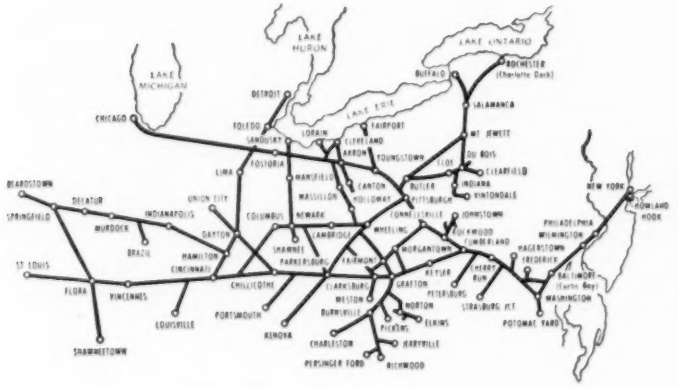
Your "burning question" is quickly answered—with

B&O Bituminous

Whether your specific question concerns power, coking, steam, or space heating, you'll find the perfect answer among the wide variety of Bituminous coals in Baltimore & Ohio territory. Here lies an almost inexhaustible source of low-cost heat and energy.

The benefits of B&O Bituminous are many. Highly mechanized mines keep production costs low, size and quality uniform. Closeness to America's industrial heart means economical transportation. The ease of storing coal eliminates the need for expensive facilities. And new methods and devices take further advantage of the burning characteristics of Bituminous.

ASK OUR MAN! He will help you find the exact coal for your purpose, and explain the best way to burn it. You'll be amazed at the efficiency, economy, and cleanliness of B&O Bituminous today.



BALTIMORE & OHIO RAILROAD

Bituminous Coals for Every Purpose

For more data circle 528 on Post Card

14 — BACK-UP RINGS

Made of Teflon, are designed to prevent extrusion of O-rings

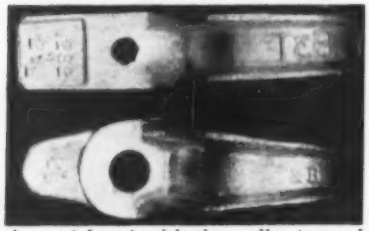
Spirally machined of tetrafluoroethylene (DuPont's Teflon) these back-up rings are said to have a high impact strength at temperatures from −100 to 500 F; to be non-corrosive, non-adhering, non-fraying, inert to most chemicals and self-lubricating. They are made for O-ring sizes to AN drawings 6227 and 6230. The Garlock Packing Co.

15 — CONDUIT STRAPS

Of malleable iron, are streamlined for more strength and less weight

By "putting the muscle only where needed" this manufacturer claims to have created a line of conduit straps offering greater strength and improved support with less weight. The one-hole straps are for rigid conduit of ½ to 6 in., and for EMT, ½ to 2 in.

One of the new, narrower straps is



shown (above) with the earlier tapered shape. It is pointed out that the new straps can be placed closer together or to equipment when the installation requires. The rectangular base has increased support area, company says, and also results in a more stable attachment, especially for installation on rough masonry. Sizes for all fittings are cast in raised numerals integral with the top of the base. The Thomas & Betts Co.

16 — VACUUM HEATING PUMP

Offers advanced design features, lower installation, operating costs

Radical changes in design of the new CSM Vacuum Heating Pump give an extremely low return line connection which reduces installation cost. Air pumping and water pumping units are separate, each with its own motor and control. Each pump operates only when needed, reducing operating cost. Because of the flexibility of the new design, capacity may be increased to accommodate additional radiation without changing basic pump installation. Nash Engineering Co.

17 — FIBER RECHARGE

Is designed for full flow filtering of large quantities of oil

This expendable, laminated fiber disc recharge is claimed to offer four to ten times the useful life of cellulose, waste or redwood for the filtering of large quantities of oil. It is classed as an extended area recharge because its actual filtering area is greater than the area of its container. The laminated discs remove foreign solids smaller than 2 mu, manufacturer reports, and the absorption of these solids after 48 hr of draining at 70 F is 2½ times the weight of the recharge. And it is pointed out that because no chemicals, bleaches or diatomaceous earths are used, the units will not remove additives from detergent oils. William H. Nugent & Co.

18 — PIPE INSULATION

One-piece molded fine glass fiber; "snaps" into place around pipe

Ultrafine Pipe Insulation is composed of extremely fine, blown glass fibers bonded with a phenolic resin and molded into one-piece sections. Manufacturer says it won't rot, mold, decay or absorb moisture; it resists attack of most acids and alkalis and is not corrosive to metal. Besides being suited for heated piping applications up to 350 F, it may be used as a "second layer" of insulation in high temperature piping, and for low temperature applications.

Several noteworthy advantages are announced for this insulation, the first of which is exceptional thermal efficiency. It is also unusually light in weight, flexible and resilient. It is insoluble in water, cuts readily, and can be painted, left "as is" or finished as desired. It comes in 6-ft lengths which afford faster installation, fewer seams and joints. Gustin-Bacon Mfg. Co.

19 — NEW CONNECTORS

Permit connecting aluminum or copper conductors to transformers

These connectors allow utilities to connect either aluminum or copper conductors to distribution transformers; they represent changes in connector design made because many utilities are now using aluminum conductors. To be furnished with all of company's pole-type distribution transformers, the new high-voltage tank-wall bushing connector features a stainless steel follow-up spring, designed to maintain a tight connection even when cold flow occurs.

Copper-alloy components of the connector are tin-plated to retard galvanic action when in contact with aluminum. However, manufacturer recommends using bi-metal adapters between connector and conductor where salt or chemical fumes are severe. The new design is said to compensate for the cold-flow of aluminum under pressure and the different coefficients of expansion of copper and aluminum. General Electric Co.

20 — DRUM SAFETY VALVE

Designed for use on 50-gal metal drums containing flammable liquids

Intended to control and prevent explosions caused by pressure expansion in 50-gal metal drums containing flammable liquids, the Vent-A-Drum is reported approved by Factory Mutual Laboratories for use with all flammable liquids except carbon disulfide and diethyl ether.

The device is screwed into the bung opening and is designed to function through a series of six automatic actions: (1) It lets air into the drum when liquid contracts or is being withdrawn. (2) It lets air escape slowly when normal temperature causes the liquid to expand. (3) It relieves excess pressure quickly when fire or unusual heat causes liquids to build up vapor pressure. (4) It automatically resets and shuts off vapor flow when pressure is relieved. (5) Fire screens inside the valve keep fire out of the drum. (6) Should the drum turn over, the Vent-A-Drum automatically seals off flow of vapor and liquid. Central Safety Equipment Co.

21 — PLASTIC VALVES

Offer corrosion resistance, high strength, relatively light weight

Made of polyethylene, except for the sealing diaphragm on the disc (a polyethylene-polyisobutylene mixture for resilience and drop tightness) these globe and Y valves are intended to withstand the corrosive action of most acids, including sulfuric, hydrochloric, nitric and hydrofluoric, as well as a variety of caustic solutions. The valves are suggested for working pressure to 50 psi and temperatures to 150 F. Now available are ½-, 1-, 1½ and 2-in. sizes. Vanton Pump Corp.

22 — FILM FORMING AMINE

Acts to minimize damage by corrosion in steam condensate systems

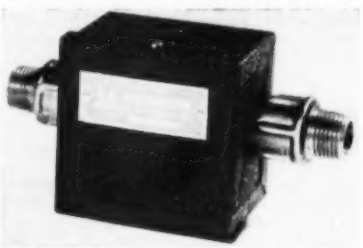
Corrosion resulting from the presence of oxygen and acid carbon dioxide can be controlled in steam condensate systems by a film-forming amine, Hagafilm, fed to the boiler in small amounts (2 to 3 lb per million lb of steam), it is announced. When fed to the boiler, Hagafilm vaporizes with the steam and deposits a thin, non-wettable protective film on metal surfaces wherever condensation occurs and throughout the return system. If only part of a return system needs this protection, Hagafilm may be injected into that branch line.

According to company Hagafilm presents no danger in handling or use — it may be used by hospitals and other plants using contact steam for cooking of food or sterilizing of instruments. Both a solid and liquid form are available. Solid Hagafilm is mixed with hot condensate to make a dispersion for feeding. The ready-mixed liquid emulsion is convenient for boiler plants where needs are relatively low. A descriptive bulletin gives details. Hagan Corp.

23 — FLOW SWITCH

Controls electrical circuits for signaling liquid flow through pipe lines

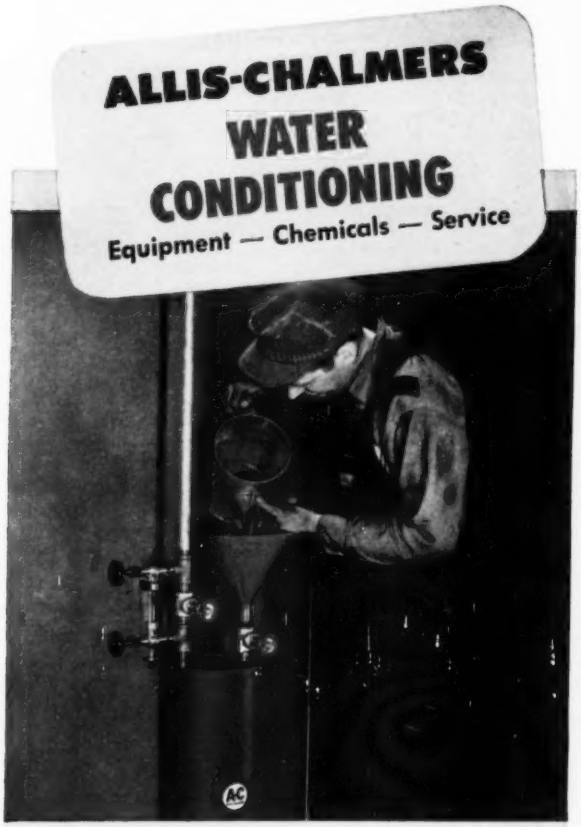
This magnetically coupled flow-indicating switch is suggested for use with water and other liquids not injurious to brass or copper. In operation, flow is



sensed by a movable vane positioned within the flow tube. Variation from desired flow rate causes a chrome-plated Alnico magnet, affixed to movable vane, to actuate contacts of a mercury magnetic tube positioned outside the flow tube. The unit has ½ in. IPS brass fittings. Two models allow maximum flows of 2.5 and 4 gpm. Winterburn Manufacturing Co.

How to Solve Boiler Problems caused by

HIGH CIRCULATING RATES



Recent trends toward high circulating and high heat transfer rates mean that careful attention to water side protection of boiler surfaces will pay off in lower fuel costs and easier maintenance. Information that will help you analyze this problem and work out an effective solution is contained in Allis-Chalmers water conditioning Bulletin 43. It explains the problem. It tells what solution is available. And it tells how to apply this solution.

Based on Allis-Chalmers Experience

Bulletin 43 is one of a series of Allis-Chalmers bulletins on water conditioning problems. Each of these bulletins contains information that will help you solve some of your problems. They are based on Allis-Chalmers wide experience handling water problems for nearly every industry. In addition, they are based on Allis-Chalmers long experience building steam turbines and power plant equipment.

Complete Service Available

Allis-Chalmers gives you complete water conditioning service. You can get analyses and reports on your problems. You can get the chemicals needed in all water treatments. And you can get the equipment needed in any system.

A-4035

Equipment for all water treatments is available from Allis-Chalmers. Picture shows feeder installation similar to equipment used in water side protection of boiler surfaces.

For your copy of Bulletin 43 on internal treatment for water side protection of boiler surfaces, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby Allis-Chalmers district office and have an Allis-Chalmers representative consult with you on your water problems.

ALLIS-CHALMERS

For more data circle 529 on Post Card

POWER PLANT *Construction News*

Calera, Ala. — American Brake Shoe Co., 230 Park Ave., New York, N. Y., castings and forgings for railway equipment, car wheels, etc., plans power house at new branch plant at Calera. It will comprise several one-story buildings, reported to cost approximately $1,000,000. Work is scheduled to begin at early date. Company engineering department, Mahwah, N. J., is in charge.

Leeds, Ala. — Crown Cork & Seal Co., Eastern Ave. and Kresson St., Baltimore, Md., metal bottle caps, closures, capping equipment, plans boiler house at proposed new branch plant at Leeds, where tract of land has been secured. Cost about $700,000. Van Keuren, Davis & Co., 3004 Seventh Ave., South, Birmingham, Ala., are architects.

Pine Bluff, Ark. — Arkansas Power & Light Co., Pine Bluff, has disposed of a bond issue of $18,000,000, proceeds to be used for expansion in generating plants and system. Company will make extensions in Lake Catherine power plant, near Hot Springs, Ark., and Cecil S. Lynch generating station, near Little Rock, Ark., with installation of new turbine-generators and auxiliary equipment.

Long Beach, Calif. — Southern California Edison Co., 601 West Fifth St., Los Angeles, plans new steam-electric generating station on a 200-acre tract of land near Lakewood, vicinity of Long Beach. Details of equipment installation and estimates of cost being determined. It will have a large capacity and will represent an investment in excess of $15,000,000, with transmission lines, power substations and other operating facilities.

Marathon, Fla. — Florida Keys Electric Cooperative Association, Tavenier, Fla., has plans under way for new steam-electric generating plant at Marathon. No official estimate of cost announced. E. P. McLean Engineering Co., Moultrie, Ga., is consulting engineer.

Cleveland, Ga. — Ames Worsted Co., Lowell, Mass., worsted goods, yarns, etc., plans boiler plant at new textile mill at Cleveland. It will be one-story, fully air-conditioned, and is estimated to cost about $2,000,000. Work will begin soon. McPherson Co., 408 So. Main St., Greenville, S. C., is architect and engineer.

Richmond Hill, Ga. — Verney Corp., Manchester, N. H., plans boiler plant at proposed new rayon weaving mill at Richmond Hill, where large tract of land has been secured. It will comprise a main one-story building for textile manufacture and a number of smaller structures. Entire project will cost about $1,000,000.

Boise, Idaho — Plan for developing the Hells Canyon-Weiser section of the Snake River in three plants has been presented to the FPC by Idaho Power Co. Proposed installations would have an aggregate installed capacity of 783,000 kw and peaking capability of 900,000 kw. The company's plan for this comprehensive development would involve an ultimate investment in hydro facilities of about $133,000,000 plus about $22,000,000 for transmission facilities.

Quincy, Ill. — Central Fiber Products Co., Quincy, plans new boiler house at plant, estimated to cost close to $125,000. H. M. Wilson Co., 18th and Brandywine Sts., Philadelphia, Pa., is consulting engineer.

New Orleans, La. — Louisiana Power & Light Co., 142 Delaronde St., has budgeted an appropriation of about $27,000,000 for extensions and improvements in plants and system in 1953–54, including generating stations, power substations, transmission lines and other operating facilities.

Baltimore, Md. — Consolidated Gas, Electric Light & Power Co., Lexington Bldg., has disposed of a bond issue of $25,000,000, proceeds to be used in connection with expansion and improvements in properties for current year, including extensions in generating plants, power substations, transmission lines and other operating facilities.

Trenton, Mich. — McLouth Steel Corp., 300 So. Livernois St., Detroit, Mich., plans power plant at proposed new steel ingot mill, blast furnace and rolling mill at Trenton, to be located on waterfront site. Entire project is reported to cost in excess of $40,000,000.

St. Paul, Minn. — Fairway Foods, Inc., 2285 University Ave., prepared food products, plans boiler house at new local processing and production plant on Como Ave., to be one-story, about 230,000 sq ft floor space. Cost close to $1,000,000. Toltz, King & Day, Inc., Pioneer Bldg., St. Paul, is architect and engineer.

Joplin, Mo. — Missouri Farmers Association, Columbia, Mo., will build a steam power house at new chemical fertilizer plant near Joplin, for which plans have been completed. Work will begin soon. It will comprise several large production buildings, with rated output of 70,000 tons per annum. Cost reported about $3,500,000.

Ogallala, Neb. — Consumers Public Power District, Columbus, Neb., plans new steam-electric power plant at Ogallala. Cost reported over $1,700,000. Proposed to begin work soon.

Dover, N. J. — New Jersey Power & Light Co. has disposed of a bond issue totaling $5,500,000, proceeds to be used for expansion and improvements in generating plants, power substations, transmission lines and other operating facilities, forming part of 1953 construction program.

Pennsgrove, N. J. — Atlantic City Electric Co., 1600 Pacific Ave., Atlantic City, has plans under way for expansion in steam-electric generating station at Pennsgrove, including installation of new turbine-generator, high-pressure boilers and auxiliary equipment. Cost about $8,000,000. Gibbs & Hill, Inc., Pennsylvania R.R. Station, New York, N. Y., is consulting engineer.

Rochester, N. Y. — Rochester Gas & Electric Corp., 89 East Ave., will expend about $35,000,000 for expansion and improvements in 1953–54, including extensions in generating capacity, power substations, transmission lines and other operating facilities.

Washington, N. C. — National Spinning Co., 350 Fifth Ave., New York, N. Y., woolen, rayon and other synthetic yarns, plans boiler house at new mill at Washington, where tract of 40 acres of land has been purchased. Entire project is reported to cost approximately $1,000,000. Work will be placed under way at early date.

Painesville, Ohio — General Chemical Div., Allied Chemical & Dye Corp., 40 Rector St., New York, N. Y., plans steam power house at proposed new plant at Painesville, to be equipped for processing and production of sulfuric acid. Cost reported over $4,000,000. Work will be placed under way soon.

Elrama, Pa. — Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa., will continue expansion in generating station at Elrama, where a new generating unit was placed in service last January. It is proposed to install another turbine-generator of 120,000-kw. rating during 1954, and a second such unit of 150,000-kw. capacity in 1955, with high-pressure boilers and auxiliary equipment, power substations, transmission lines, etc. Complete program will represent an investment of about $115,000,000.

Providence, R. I. — Narragansett Electric Co., 51 Westminster St., has approved plans for expansion in steam-electric generating station on South St., with installation of additional equipment and facilities. Work will be carried out over a period of several months and is reported to cost in excess of $4,000,000. United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa., is consulting engineer.

Sioux Falls, S. D. — Summers Fertilizer Co., Inc., Totman Bldg., Baltimore, Md., plans boiler plant at new commercial fertilizer works at Sioux Falls, where site has been secured. It will comprise a main one-story building for general production and several smaller units. Entire program is estimated to cost about $275,000.

Corpus Christi, Tex. — Bd. of Trustees, University of Corpus Christi, has plans under way for new boiler house at institution for central-heating service. Cost reported about $350,000. Work will be carried out in connection with a number of new buildings at college, entire program to cost over $3,000,000. Harland Bartholomew & Associates, 317 North 11th St., St. Louis, Mo., are architects.

Corsicana, Tex. — Burrus Mfg. Co., Lincolnton, N. C., plans boiler house at new furniture manufacturing plant at Corsicana, where site has been acquired. Cost reported about $270,000. Proposed to begin work soon.

Garland, Tex. — Municipal Electric Department has plans maturing for expansion and improvements in municipal power plant, reported to cost about $500,000. Forrest & Cotton, Praetorian Bldg., Dallas, Tex., are consulting engineers.

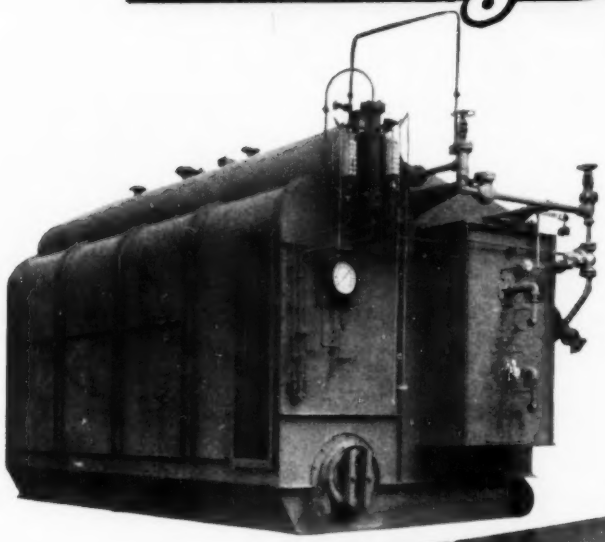
Texas City, Tex. — Bakelite Co., division of Union Carbide & Carbon Corp., 30 East 42nd St., New York, N. Y., is reported planning power plant at new factory at Texas City, for manufacture of polyethylene plastic materials and other chemical specialties from natural gas. Project will consist of several processing and production buildings, and is estimated to cost close to $6,000,000.

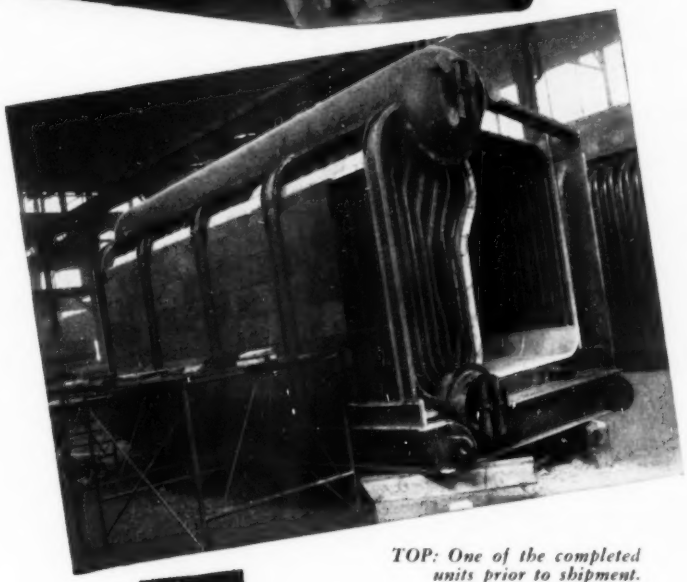
Roanoke, Va. — American Viscose Corp., 1617 Pennsylvania Boulevard, Philadelphia, Pa., rayon products, has authorized new steam-electric generating plant at mill at Roanoke, with installation of 5000-kw. turbine-generator, high-pressure boilers and auxiliary equipment. Cost estimated about $3,600,000. Work will be placed under way at early date.

Belle, W. Va. — E. I. duPont deNemours & Co., duPont Bldg., Wilmington, Del., has authorized construction of a "partial-coal combustion" generating unit, to utilize a soot-free process for production of synthesis gases at chemical plant at Belle, to replace existing gas-generating installation. It will be of special design and is estimated to cost about $4,000,000. Proposed to carry out project soon; it will require a number of months for completion.

Vogt

Gas Fired
PACKAGE UNIT
Steam Generators
selected by
PHILLIPS CHEMICAL CO.
Pasadena, Texas Plant





TOP: One of the completed units prior to shipment.

BOTTOM: Shop erection view shows tile and block insulation in convection wall; also main baffle tile and furnace floor tile.

Principal Data, Each Unit

25,000 pounds steam per hour capacity. Induced draft type.
Fusion welded steam and water drums designed for 425 pound S.W.P.
Completely shop assembled and required only the piping and gas outlet connections to place them in operation.
Fully steel encased for outdoor installation on a simple foundation.

•

**Vogt Steam Generators are available in bent tube types and straight tube forged sectional header types for solid, liquid or gaseous fuels. Bulletins on request.*

HENRY VOGT MACHINE CO.
Louisville, Kentucky

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

For more data circle 530 on Post Card

Know the pitch!

Specify **SCOVILL** PHOSPHORIZED

ADMIRALTY HEAT EXCHANGER TUBES

With Scovill men and methods on your team, you will get plenty of practical, helpful "signals" to long-life heat exchanger tube performance.

Scovill Phosphorized Admiralty Tube (Alloy 363), for example, is *made* differently... hot extruded from CONTINUOUS-CAST billets. As a result, it is *always* uniform in composition and temper; inhibitor content (phosphorus) is *always* at optimum percentage. Such tube shows superior resistance to corrosion and dezincification, especially where contaminated fresh, salt, or brackish waters are used in the circulation system.

Equally important, Scovill provides what many consider to be the most competent and comprehensive Heat Exchanger Tube Technical Service in the field. We make it our business to see that you get the right tube for your application and conditions... selected from the wide range of heat exchanger tube alloys we produce.

Inquiry and an outline of your needs are encouraged. Write on your business letterhead for our 40-page heat exchanger tube booklet. Scovill Manufacturing Company, 99 Mill Street, Waterbury 20, Conn.

SCOVILL
HEAT EXCHANGER TUBE ALLOYS

- PHOSPHORIZED ADMIRALTY
- ADMIRALTY
- ARSENICAL ADMIRALTY
- MUNTZ METAL
- NAVAL BRASS
- RED BRASS, 85%
- DEOXIDIZED COPPER
- ARSENICAL COPPER
- COPPER NICKEL, 10% & 20%
- CUPRO-NICKEL, 30%
- CUPRO-NICKEL, 30% (High Iron)
- ALUMINUM BRASS
- ALUMINUM BRONZE, 5%
- DUPLEX TUBE

SCOVILL

29C53

"You can't buy better Brass"

For more data circle 531 on Post Card

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 1 | AUGUST 1953 | Number 4

Coal Washer Maintenance Costs Cut in Half

Maintenance costs on the coal washer for a big steel plant were running as high as $18,000 a month when Bill O'Brien, Hall field engineer, was consulted. The main trouble in the washing process arises when iron pyrites in the coal come in contact with air and water. Sulphuric acid is formed, and plays hob with the equipment. Drawing on his experience with similar situations, Bill prescribed treatment of the wash water with Banox* corrosion inhibitor. Maintenance has already been cut in half, unscheduled shutdowns have been eliminated, and further improvement can be anticipated.

Water is your industry's most important raw material. Don't waste it.

Epsom Salt Sales Boom in West

Hall-man Hankison of Denver reveals what associate W. C. Bennett did to keep a client happy.

A new 1500 psig boiler filled with raw water required fast silica reduction. No magnesium compounds were available at the plant for the purpose, so Bennett went to a drugstore and asked the clerk for five pounds of Epsom Salts. The clerk looked startled, the order was repeated, and the sale made.

Only five pounds wasn't enough. So the next evening he returned to the drugstore for an additional five pounds.

This was too much for the clerk, who braced himself firmly, looked Bennett squarely in the eye, and said explosively, "What FOR?"

Report Shows Scope of Hall Service

The following extracts from a recent report of Basil Welder, Hall Service Engineer, demonstrates what is meant by "Hall Plant-Wide Water Service." The Hall Service Engineer is not only informed on industrial water but is also alert to the many factors of operation and layout which affect results.

- Persuaded steel plant to make mechanical changes in open-hearth door frames to improve cooling.
- Located leak of clay slip into condensate return system of ceramic plant.
- Introduced Hagafilm* for control of corrosion in condensate return system of glass plant.
- Established system for treating water in five air-conditioning systems in large department store.
- Recommended special filter to plant manufacturing compressed gases, reducing oil in condensate to insignificant level.
- Used Burosil* in boilers of synthetic-fuels laboratory to get rid of sludge through precipitation of magnesium.
- Prepared survey of alternative systems of primary treatment of feedwater for new boilers of steel plant.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems, for information, write, wire or call Hall Laboratories, Inc.

Lamme Medal Awarded Dr. Hall

The Benjamin G. Lamme medal, one of Ohio State's top honors, was awarded to Dr. Ralph E. Hall at the spring quarter commencement exercises. Dr. Hall received the award for meritorious achievement in engineering.

Said the Ohio State Lantern in announcing the award, "Not only is Dr. Hall credited with the development of water conditioning into an exact science based on sound scientific principles, but his contributions to the entire power industry are considered invaluable. Today the Hall system of boiler water treatment is practically standard throughout the world."

From its founding in 1926, until his retirement in 1950, Dr. Hall was director of Hall Laboratories. He still serves as a consultant to Hall Laboratories on both research and development problems in their work as water consultants to industry.

Dr. Hall is the author of 64 papers, and some 54 patents have been issued on Hall processes. He is a member of the American Chemical Society, the American Society of Mechanical Engineers and two national honorary societies, Phi Beta Kappa and Sigma Xi.

*"Banox," "Hagafilm" and "Burosil" are registered trademarks. "Hall System" is registered as a service mark by Hall Laboratories.

Largest "S" Monel Pump Impeller ever cast at Inco's foundry. This 3,023-pound impeller is installed in an 84-inch Morris Vertical Axial Flo pump, at a generating plant of DOW CHEMICAL COMPANY, Velasco, Texas. The pump was built by the MORRIS MACHINE WORKS, Baldwinsville, N. Y., and is capable of handling 120,000 gpm at a total discharge head of 10.5 feet. It will operate in brackish water taken from the Gulf of Mexico. Because of Dow's experience with these corrosive conditions they selected "S" Monel for the impeller as a precaution against costly shut-downs. And for added protection, they also specified centrifugally cast pump sleeves of Monel.

"S" Monel...

an extra-hard casting alloy for parts subject to the severe conditions of power plant service

A time usually comes when you need a corrosion-resisting alloy of above-average strength and hardness.

Then it pays to remember "S"® Monel.

This member of the Monel family is one of the *strongest* and *hardest* of the non-ferrous alloys available in cast forms. Because of its hardness, of course, "S" Monel is highly resistant to abrasion and erosion. What's more, it combines the excellent corrosion-resistance of Monel with two particularly valuable features:

— extra hardness at high temperatures
— resistance to galling and seizing

Worth keeping in mind, too, is that "S" Monel maintains a hardness nearly as great as heat-treated steel. Temperatures as high as 1000°F. have but slight effect on its hardness.

And "S" Monel is machinable as cast. Where extensive machining operations are called for, the casting may be annealed. Age-hardening later will develop maximum hardness.

It is this combination of exceptional properties that makes "S" Monel so useful in valve discs and seats, wearing rings, bushings, sleeves, ejector nozzles, pump liners and impellers.

In your own plant, there are probably many places where Inco-Cast "S" Monel parts could contribute to the improved performance of parts subject to high stress, high temperature and severe friction under corrosive conditions. You can get complete information on "S" Monel — and assistance on actual problems, too — simply by writing to Inco's Technical Service Section.

It is advisable to place equipment orders with your supplier well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Inco Nickel Alloys

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
INCONEL® • INCONEL "X"® • INCONEL "W"® • INCOLOY® • NIMONIC® ALLOYS
NICKEL • LOW CARBON NICKEL • DURANICKEL®

For more data circle 533 on Post Card

How to INCREASE BOILER RATINGS with your present furnace and stack

Coppus-Dennis FANMIX Burners Give You More Heat with No Other Major Change in Equipment

Coppus-Dennis FANMIX Burners give you *perfect* mechanical mixing of fuel and air *at the burner outlet . . . instantaneous* ignition close to the burner . . . and *complete* combustion *without visible flame* when burning natural gas. No other burner combines these three advantages.

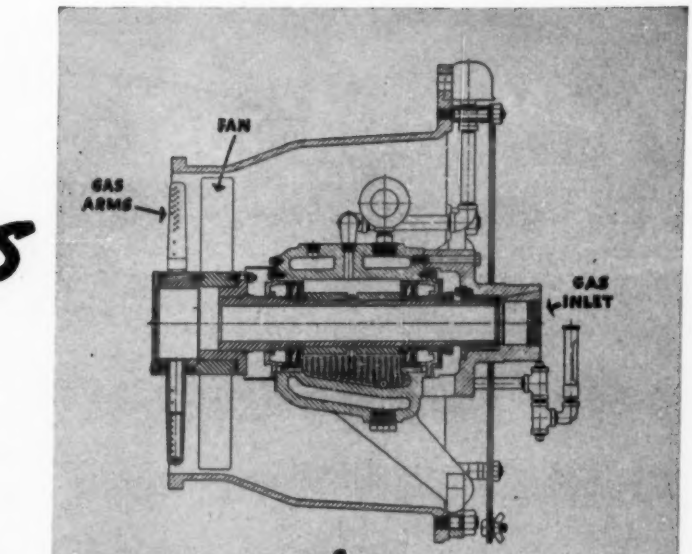
Because FANMIX delivers the *right* mixture of fuel and air *without blow-torch action*, all of your furnace space is used for combustion . . . *none for mixing*. That's why your present furnace can release more heat . . . why new installations can get more heat out of smaller furnace space.

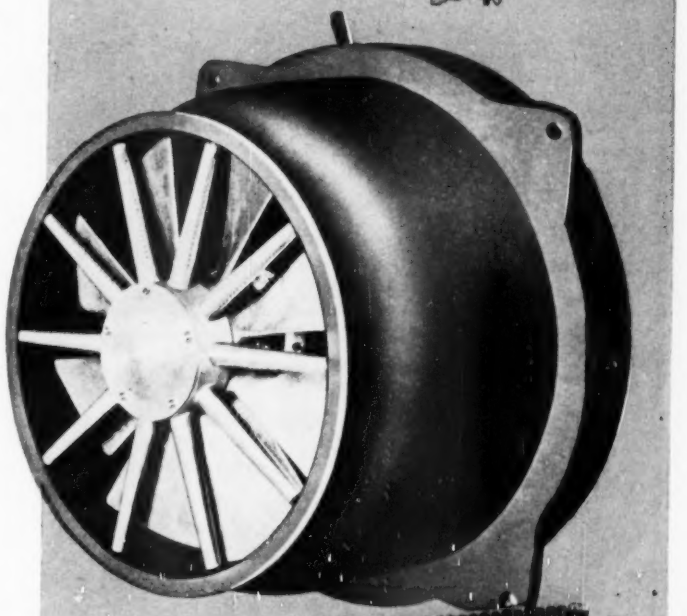
Because FANMIX can be guaranteed to secure complete combustion of natural gas *with less than 5% excess air*, you get uniform "radiant heat" *without drifting hot spots*. That's why a FANMIX-fired furnace seldom varies in temperature more than 5% over its entire area.

WRITE FOR ALL THE FACTS

When you see in Bulletin 410-6 how fuel escaping from orifices in rotating driver arms rotates the fan to draw the correct proportion of air into the path of the fuel at right angles . . . how FANMIX creates its own forced draft, reduces stack requirements, prevents cracking of "wet" gas . . . how two FANMIX types handle either gas or oil or any combination of both — you'll understand why FANMIX Burners have such wide acceptance in oil refineries and power plants.

Send for the Coppus-Dennis FANMIX Bulletin 410-6. Coppus Engineering Corporation, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, and REFINERY CATALOG.





ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP.
168 Park Ave., Worcester 2, Mass.
Please send Bulletin 410-6 to:

Name .....

Company .....

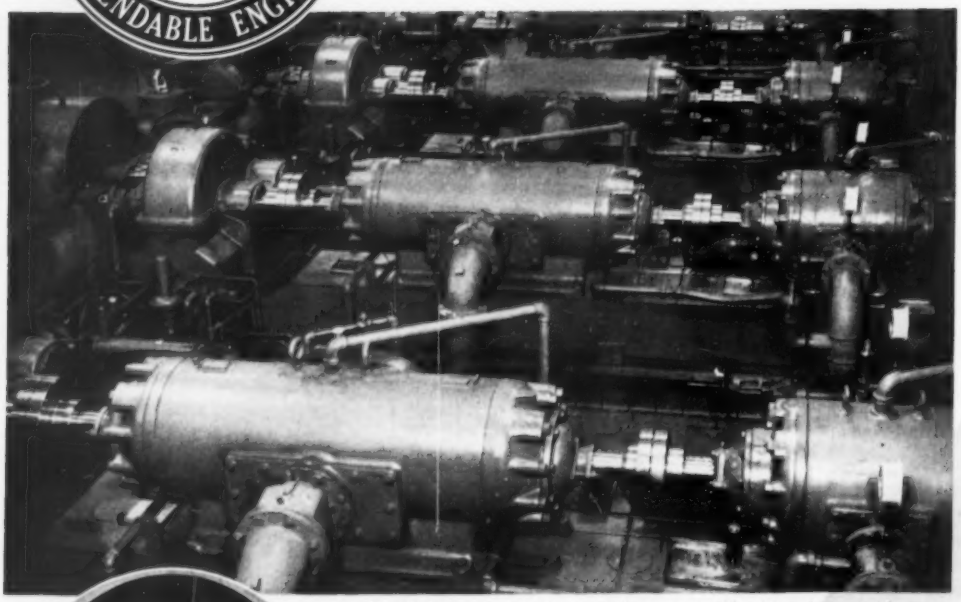
Address .....

For more data circle 534 on Post Card

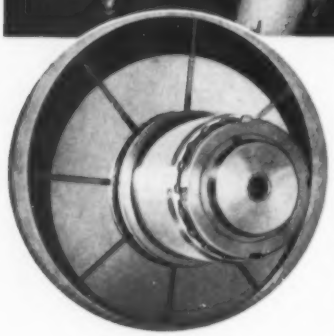
PRATT & WHITNEY AIRCRAFT

DEPENDABLE ENGINES

PRATT & WHITNEY AIRCRAFT



Four Fuller Rotary Compressors, Elliott steam-turbine driven, have a total capacity of 6760 c.f.m., at 110 p.s.i.



depends on FULLER AIRPOWER

Four Fuller Rotary Two-stage Compressors put Pratt & Whitney Aircraft's engine plant in East Hartford on a 100 p.s.i. air diet for such operations as shot peening, spray booths, air cleaning, and air-operated chucks.

Pratt & Whitney Aircraft has joined no *small* family of users; food and chemical plants, steel mills and cement mills, gas-gathering plants, refineries, automobile plants, foundries and machine shops, public utilities, and many others depend on Fuller for compressor equipment, wherever air is required.

Whether *your* air-plans call for single-stage, two-stage — single-stage duplex or two-stage duplex—you can be sure Fuller has the compressors which gives you a dependable source of pulsation-free air up to 3300 c.f.m., 125 p.s.i., with maintained capacity for the life of the machine.

Write for Bulletin C-6, Fuller Rotary Compressors.

FULLER COMPANY, Catasauqua, Pa.
Chicago 3—120 So. LaSalle St.
San Francisco 4—420 Chancery Bldg.

Fuller

PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS

C-225
1624

For more data circle 535 on Post Card

Better Valves–Year After Year

Fig. 19003 W. E. 900-pound Cast Steel Pressure Seal Gate Valve with welding ends. Also made for 600, 1500 and 2500 pounds W. S. P.

Because for more than a hundred years Powell Engineers have never been willing to "let well enough alone," the Powell Line of Valves has been continually improved and expanded to satisfy every new demand of industry.

That is why you'll find a greater variety of Powell Valves in service today than of any other individual make.

Shown here are a few of the many Powell designs for the modern Power Plant.

The Wm. Powell Company
Cincinnati 22, Ohio

DEPENDABLE VALVES SINCE 1846

POWELL

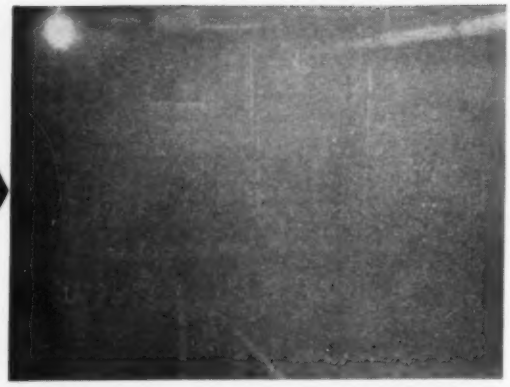
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES

For more data circle 536 on Post Card

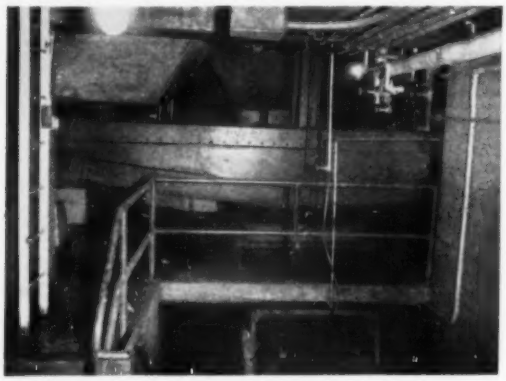
STOP COAL DUST

for 1/10 Usual Cost

at car dumpers, hoppers, crushers, belt galleries, and coal piles



BEFORE — Reciprocating feeder and belt housing in operation at large Illinois utility with Johnson-March System turned off.



AFTER — The same operation taken with the Johnson-March System turned on. Note complete absence of dust. Name of utility will be gladly furnished upon request.

● The Johnson-March Dust Control System *stops dust before it becomes airborne!* And it does it *without expensive ducts, fans and other cumbersome equipment!*

Hundreds of J-M installations daily stop dust efficiently and economically at such sources as car dumpers, hoppers, crushers, belt galleries and coal piles.

Cost of this positive dust control system averages less than 1/10 the cost of other methods. Maintenance costs are next to nothing. Installation is fast, simple and inexpensive. There is no interference with normal plant operations.

Our engineers will be glad to discuss this positive, low-cost system at no obligation. Write today for detailed information.

Johnson March

Specialists in Dust Control

Dept. PE-5 1724 CHESTNUT ST. Philadelphia 3, Pa.

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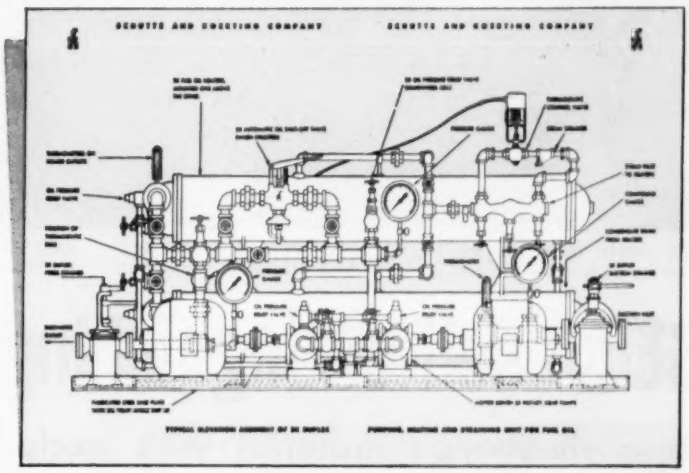
TRADE PAPER EDITION
Published by
SCHUTTE and KOERTING
Company

ENGINEERING *News*

JET APPARATUS • HEAT TRANSFER EQUIPMENT • STRAINERS • CONDENSERS AND VACUUM PUMPS • OIL BURNING EQUIPMENT • ROTAMETERS • FLOW INDICATORS • RADIAFIN TUBES • VALVES • SPRAY NOZZLES AND ATOMIZERS • GEAR PUMPS • DESUPERHEATERS

POWER ENGINEERS WHO HAVE "PACKAGED" SK PUMPING, HEATING, and STRAINING UNITS SAY, "DEPENDABLE, REQUIRE LITTLE MAINTENANCE"



YOU CAN FIND OUT WHY BY ASKING FOR A COPY OF NEW BULLETIN 16-H

Checking back on installations is a 77 year old SK tradition which pays off for both our customers and ourselves. They get an opportunity to consult with our engineers about the equipment and techniques of operation. We get a chance to hear stories like these about SK Pumping, Heating and Straining Units—

At the plant of a large paper manufacturer:—SK Unit handles 40 gpm Bunker "C" Fuel Oil at 300 psig oil pressure. Oil temperature runs 90° F.—225° F. One pump of the unit is motor driven; the other has steam turbine drive. Customer says it does a *good* job.

At the plant of a famous brewing company:—An SK Duplex Pumping, Heating, and Straining Unit handles 19 gpm of Bunker "C" Fuel Oil at 125 psig. Oil suction temperature is about 90° F., oil heater outlet temperature is about 200° F., steam pressure averages about 125 psig. The plant engineer considers the equipment to be "highly satisfactory in every respect."

At a large hospital:—SK Pumping, Heating, and Straining Unit is equipped with one horizontal duplex steam driven piston pump and one SK motor driven pump. Engineer says of unit, "It's dependable, requires little maintenance."

SK Pumping, Heating, and Straining Units are described, with principal components, in *new* Bulletin 16-H, just released. You can get a good idea of how these units are designed, how they operate, what special modifications can be made, what their characteristics include by writing for this bulletin at the address below.

Remember, the bulletin is 16-H.

SCHUTTE and KOERTING Company

34 STATE ROAD
CORNWELLS HEIGHTS
BUCKS COUNTY, PA.
Representatives in Principal Cities

For more data circle 538 on Post Card

ONLY UNDER DIRECT FLAME, will GE's new self-extinguishing insulation for metal-clad switchgear char —as demonstrated in this picture with flame of blow-torch applied directly to the new laminated sheet-type insulation.

GE's "self-extinguishing" insulation gives

New sheet-type material with exclusive, flame-retardant feature localizes damage that may occur under abnormal conditions

The equivalent of a "built-in fire extinguisher"—a flame-retardant insulation for switchgear, marks the most recent General Electric development for even safer, more dependable metal-clad switchgear—industry's standard for 2400- to 13,800-volt circuits.

In introducing this flame-retardant insulation—which was perfected by Nicholas F. Arone, engineer in its Switchgear Department in Philadelphia—G.E. has gone far to minimize all potential fire hazards in switchgear.

All good insulating material has three standard properties: high mechanical strength, high dielectric strength, and a non-hygroscopic quality. To this group, G.E. is the first to add an important fourth property: a self-extinguishing characteristic that *refuses to sustain combustion.*

The laminated insulation sheet will burn and char—but *only* if an outside source of flame remains in contact with the sheet itself. Once the source is removed, polyvinylchlorides "smother" the flame in less than a minute—localize damage—and permit quick access to compartments for inspection and maintenance.

In bus and cable supports, in insulating barriers between compartments, in box barriers for arc chutes—throughout vital spots of metal-clad, GE's new flame-retardant insulation works for greater protection under *all* conditions—without extra cost to you.

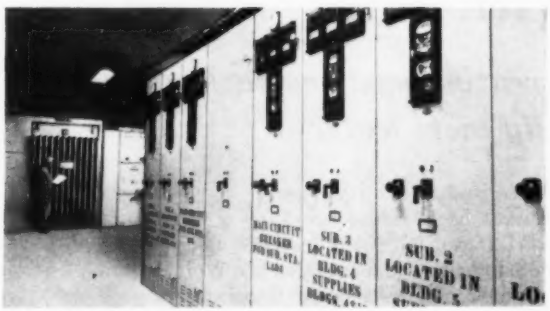
For information on improved Metal-Clad Switchgear, with new, flame-retardant insulation, call your nearest G-E sales representative, or write to General Electric Company, Schenectady 5, N. Y. 874-3

G. E. BURENS, *general manager, Switchgear and Control Division, presents Coffin Award to N. F. Arone for development of outstanding new insulation. Coffin Award is General Electric's highest employee honor.*

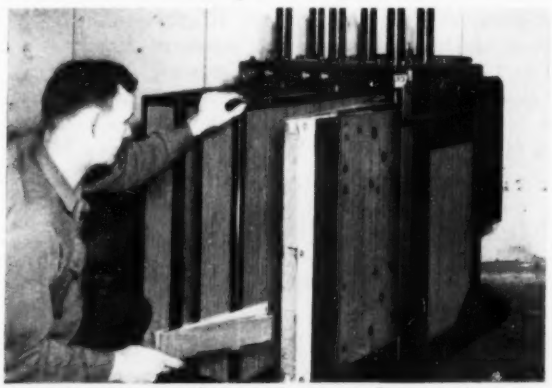
GENERAL ELECTRIC

WITH FLAME REMOVED, the flame-retardant insulation refuses to sustain combustion—and extinguishes itself in less than 60 seconds. Polyvinyl-chlorides in the laminated sheet "smother" the flame, permitting ready access to compartments for inspection and maintenance.

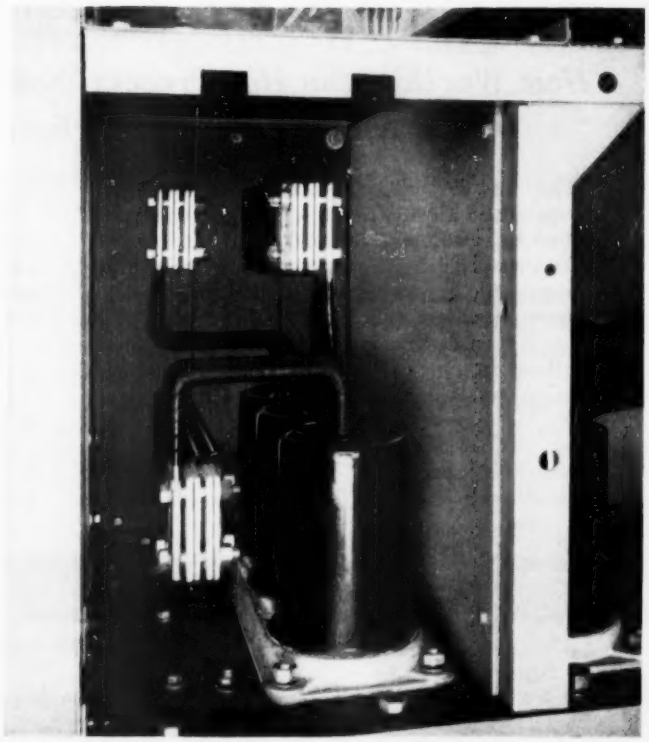
added protection to metal-clad switchgear



THIS METAL-CLAD SWITCHGEAR lineup features GE's new flame-retardant insulation at vital points throughout all sections.

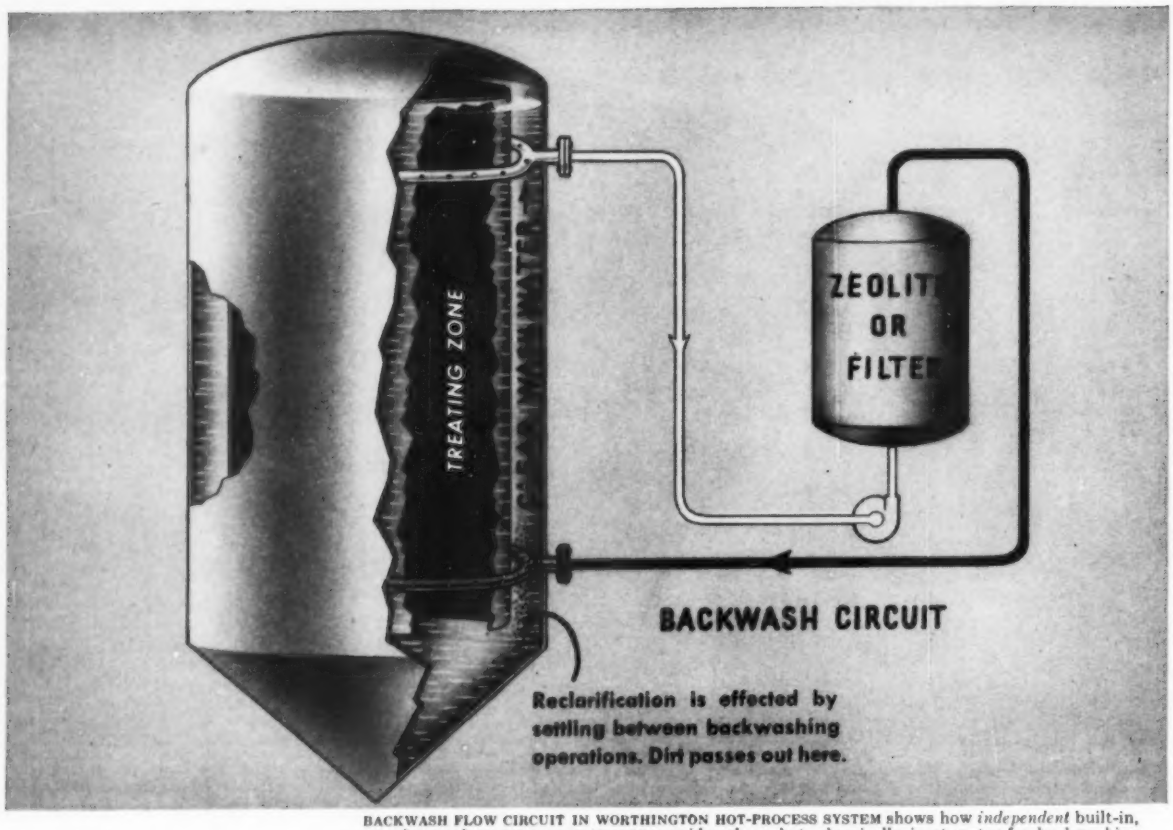


INSULATING BARRIERS for arc chutes are flame-retardant, non-hygroscopic, possess high mechanical and dielectric strength.



COMPARTMENTIZED SECTIONS, in addition to self-extinguishing insulation as shown in this bus section, limit damage from abnormal conditions.

For more data circle 539 on Post Card



BACKWASH FLOW CIRCUIT IN WORTHINGTON HOT-PROCESS SYSTEM shows how *independent* built-in, annular wash-water compartment* provides clean, hot, chemically inert water for backwashing and reclaims it without affecting operating velocities in treating zone, or subjecting hot zeolite to temperature changes. Backwashing is accomplished by recirculation of the clarified wash water.

*Reg. U.S. Pat. Off. 2,263,398

You can't wash clean with dirty water!

How Worthington Hot-Process Water-treating systems backwash with CLEAN, hot, chemically inert water

When you're considering hot-process water-treating systems with hot zeolite, filters, or both, *don't overlook backwashing facilities.*

They must be well designed, or the system cannot give smooth, efficient, trouble-free performance. Worthington engineers recognized this fact when they designed their first hot-process system. Today, every Worthington standard Hot-Z or conventional system provides exclusive *independent* facilities for backwashing zeolite or filters with clean, hot, chemically inert water without disturbing the normal flow through the reaction bank.

Worthington water-treating specialists don't believe you can wash clean with dirty water.

This unique backwashing provision is just one of many Worthington patented features, but it alone will more than justify your selection of a Worthington system for hot-processing boiler feedwater in your plant.

If you have a problem, whether it involves filtration, precipitation, or zeolite treatment, Worthington specialists will be happy to study your water-treating problem and recommend the proper system. Just write, stating service conditions in detail, to Worthington Corporation, Water Treating Division, Harrison, N. J.

J.2.1

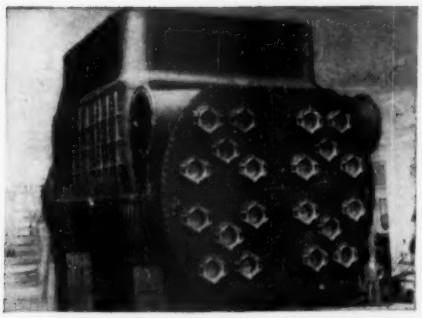
Worthington Makes More of the Equipment for ALL Types of Water Conditioning Systems

WORTHINGTON

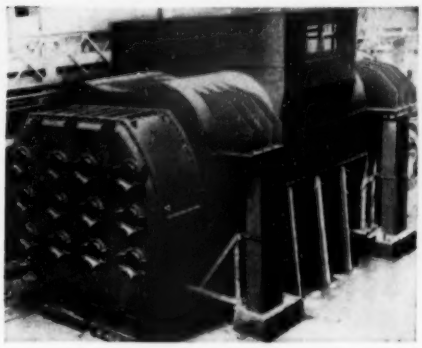
Water Conditioning

For more data circle 541 on Post Card

CON EDISON'S EAST RIVER ELECTRIC GENERATING STATION at 14th Street, New York City, will contain the new Worthington 125,000 sq-ft condenser. The shell, which is to be installed under 160,000-kw Unit No. 7, will contain nearly 105 miles of ¾" O.D. aluminum brass tubes and will require 138,000 gpm of East River water supplied by two 54 in. Worthington "Mixflo" vertical single suction volute circulating pumps.



WORTHINGTON CONDENSER installed in 1931 to serve 160,000-kw Unit No. 7, Hudson Avenue Station. Tube sheets were drilled for 110,000 sq ft with 101,000 sq ft installed.



ONE OF TWO 74,500 SQ-FT 2-PASS WORTHINGTON CONDENSERS serving 60,000-kw Units 14 and 15 at Waterside Station No. 1.

Con Edison once again installs "largest" condenser

On several occasions over the past fifty years, Worthington has been selected to build the "world's largest" surface condensers in single shell design.

In 1919, a 70,000 sq-ft condenser was installed under a 35,000-kw turbine-generator for a prominent utility company. This was the largest single shell surface condenser of its day.

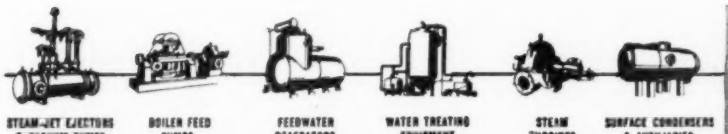
In 1931, Brooklyn Edison Company (now Consolidated Edison Company of New York, Inc.) installed, under 160,000-kw Unit No. 7 at the Hudson Avenue Station, the "world's largest" at that time, a 101,000 sq-ft single-pass Worthington condenser. This was followed, in 1949, by two 74,500 sq-ft condensers for Waterside Station No. 1.

Now, Worthington is again building for Con Edison the "world's largest" single-shell condenser ever ordered, 125,000 sq-ft, single-pass, for the 160,000-kw Unit No. 7 addition to East River Station.

Worthington, with over a century of experience in the manufacture of steam power equipment, is prepared to build efficient condensers in all sizes. Let us advise you, without obligation, on your new installation.

Write, stating requirements, to *Worthington Corporation, Steam Power Division, Harrison, New Jersey.*

Z.2.2



World's Broadest Line of Steam Power Plant Auxiliaries

WORTHINGTON

Condensers

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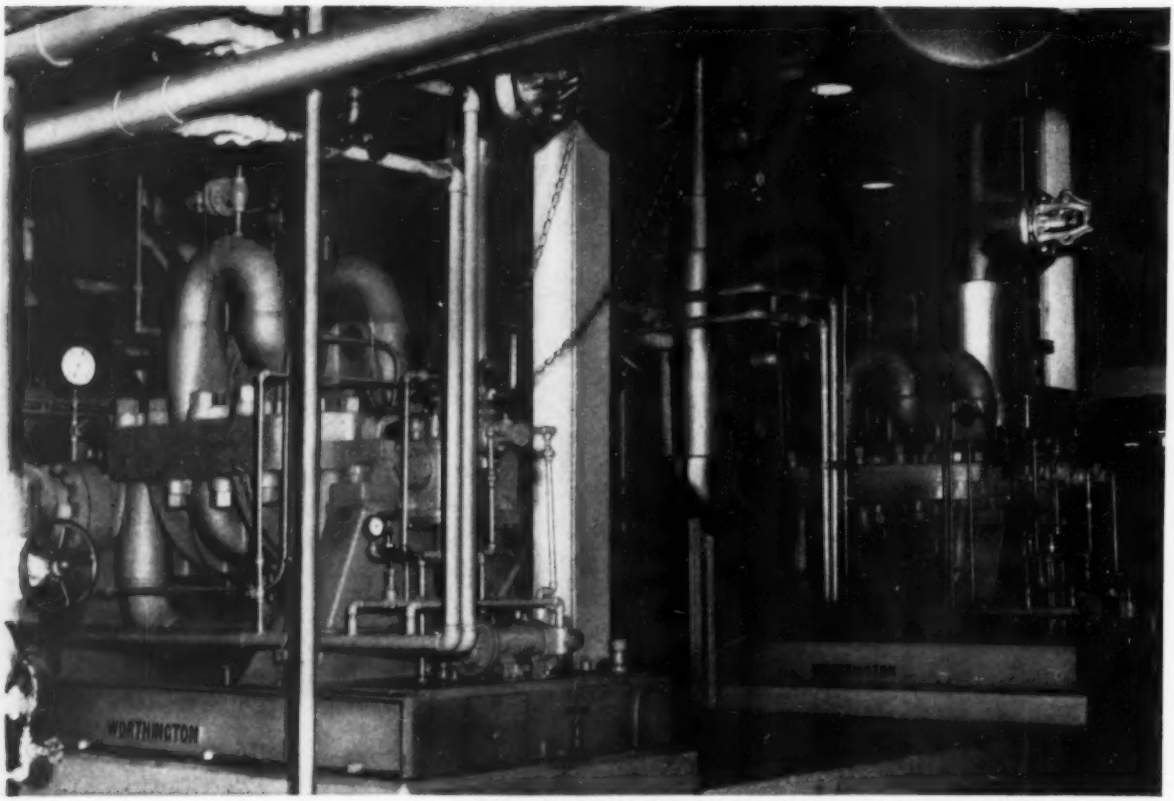


THIRTY WORTHINGTON BOILER FEED PUMPS have been purchased by the Southwestern Public Service Company of Amarillo, Texas. The two boiler feed pumps above, installed at Southwestern's new Plant X, deliver 1165 gpm, at 1125 psi total head.

Worthington helps bring more power to the Southwest

30 Worthington boiler feed pumps installed by Southwestern Public Service since 1945

Plant X, ten miles north of Amherst, Texas, is the newest and largest of the Southwestern Public Service Company's eleven generating stations. Since September, 1945, Southwestern Public Service has been expanding, building new stations to meet the Southwest's increasing power needs.

Worthington has played an important part in this expansion. During the past eight years, thirty Worthington boiler feed pumps have gone into Southwestern Public Service power plants. In Plant X alone, Worthington has supplied, in addition to the boiler feed pumps, heater drain pumps, water softeners, sump pumps, air compressors, and the open feed-water heater.

Power engineers everywhere have found that Worthington has kept pace with the increase in capacity and pressure of steam generating units and is prepared to furnish boiler feed pumps for any modern power plant requirements.

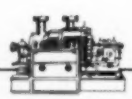
We'd like to hear about your own pumping problems. Get in touch with your nearest Worthington district office, or write directly to Worthington Corporation, Centrifugal Pump Division, Section C.3.5, Harrison, N. J.

C.3.5

For Boiler Feed Service. Capacities to 1,500 GPM; Heads to 1,000 feet.

For Hotwell, Condensate, Chilled Water Service. Capacities to 1,400 GPM; Heads to 650 feet.

For Water Works, Circulation, Drainage, General Service. Capacities to 135,000 GPM; Heads to 400 feet.



For Boiler Feed Service. Capacities to 3,000 GPM; Heads to 7,000 feet.

WORTHINGTON

Centrifugal Pumps

The World's Broadest Line Assures You the Right Pump for Every Job

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The New GRINNELL MODEL R CONSTANT SUPPORT HANGER

FEATURES OF GRINNELL MODEL R CONSTANT SUPPORT HANGER:

- 3 frame sizes provide maximum travel of 4 inches, 8 inches and 12 inches respectively to accommodate all loads from 48 to 9,304 pounds
- Non-resonant
- Anti-friction needle bearings keep friction to a minimum
- Individually calibrated before shipment to support exact load specified
- Requires less head room
- Can be bolted directly to the building structure or suspended by either single or double rods

SEND FOR DETAILED CATALOG ON NEW GRINNELL MODEL R CONSTANT SUPPORT HANGER

Mathematically perfect constant support for all positions of travel of high temperature process and steam piping

With the new Grinnell Model R Constant Support, the pipe, its covering and contents, are supplied mathematically perfect support in all positions of travel. In addition, constant support is maintained throughout the full range of field adjustability.

The design of the new Model R provides favorably small ratios between spring force and the supported load, ranging from 1.15 to 1 minimum and 4 to 1 maximum, thereby minimizing bearing stress and prolonging the life of the hanger. This permits hangers which are smaller in size for the loads carried.

If conditions require a change of supporting force, a load scale is provided so that accurate field adjustments of at least plus or minus 10% may be made by turning a *single* load adjusting bolt. Wherever the adjustment is set, the Model R gives a load deflection curve that is a straight horizontal line.

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AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

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Looking for the right packing for your centrifugal pumps?

For shaft speeds to 1750 RPM Johns-Manville Centripac seals better

WEAR on centrifugal pump shafts as well as on oscillating and rotating rods of other equipment is minimized by J-M Centripac. This is because the square cross section of this packing provides the maximum contact surfaces. Thus, it insures a tight seal with the least friction and gland pressure.

Because Centripac is plaited square it retains its shape indefinitely, thus maintaining maximum surface contact for long periods of time. It is made from long-fiber asbestos yarn, thoroughly lubricated and graphited. It seals against fresh or salt, hot or cold water, oil, ammonia, brine, gasoline, and certain weak acids and other chemicals. Because of its wide application, it is a favorite of plant men everywhere.

For general service, Style #7 Centripac is recommended. It contains no wire, is soft enough to conform readily to the packing space, and stands up well in service. It comes in coil form, Style #C-7 and Ring form, Style #R-7. Sizes 3/16" and up.

For higher shaft speeds, J-M Plastic Packings reduce friction and scoring of shafts and sleeves

Higher centrifugal pump speeds make friction increasingly important in packing and shaft life. That is why J-M Plastic Packings have been designed to have the homogeneous structure and low friction so essential to long packing life in this service.

The exact composition of these packings varies according to the service conditions for which each particular style is designed. As an example, one of these, Style No. 610 is an excellent general maintenance packing for service against steam, air, ammonia, gases, etc. up to 550F. It is made of selected asbestos fiber mixed with pure graphite and a small amount of non-friction metal, then bonded with a heat-resisting compound to form a pliable coil or spiral. It is furnished in sizes of 1/8" and up.

YOUR J-M PACKING DISTRIBUTOR will gladly recommend the right packing for your equipment, and furnish it from stock for your immediate requirements. Write Johns-Manville, Box 60, New York 16, N. Y. for his name and address. In Canada, 199 Bay St., Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS and GASKETS

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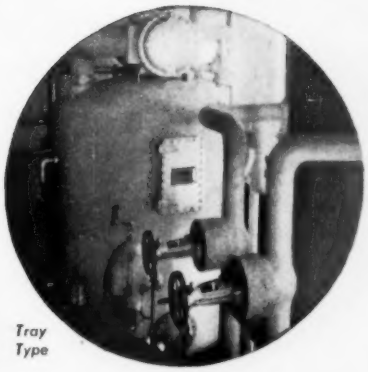
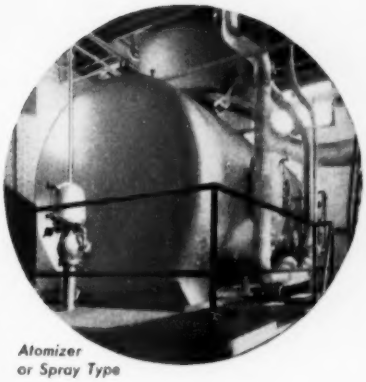
DEAERATOR TYPES FOR ALL SERVICE REQUIREMENTS

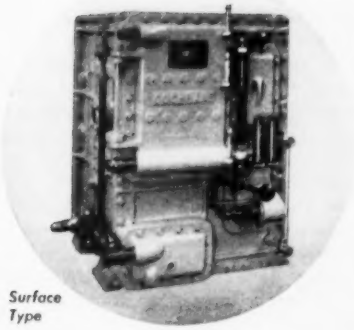


Tray Type



Atomizer or Spray Type

Jet Tray Type



Surface Type

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Over 90 years of specialized experience in water conditioning are at your service when you call a Cochrane Engineer. Write for the address of our office nearest you. We'll be happy to discuss your requirements without obligation.

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BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Announcing Bridgeport's New "Condenser and Heat Exchanger Tube Handbook"

For a better understanding of tube corrosion and maintenance problems

Which condenser tube alloy will give the best service life? To help solve this problem Bridgeport Brass Company has published a 156-page book which deals with the properties of available copper-base alloys for condenser tubes and their applications in the chemical, petrochemical, processing industries, power and marine fields.

Copper and copper alloy tubes are used for conveying corrosive liquids, exchanging heat, refrigeration, steam generation, reclaiming waste heat, evaporating, distilling, condensing, fractionating, extracting oil by means of solvents, etc.

Tubes carry many processing liquors, cooling waters, gases, acids, salts, bases, and organic compounds in water and other solvents. Each application requires careful study and sometimes experiments by trial in service.

Causes of Corrosion

The new book deals with corrosion problems. Much information is based on facts developed through laboratory corrosion research and field tests. Such data when correlated with actual operating experience are helpful in specifying which alloys will give best results for specific applications.

A large section of this book is devoted to corrosion from water which is probably the most widespread cause of corrosion. This subject has been covered from such angles as effects of alloy composition, water composition, pH values, soluble salts, dissolved gases, protective and nonprotective films, biofouling, oxygen concentration, impingement, foreign matter, dezincification, temperature, inhibitors, etc. Also dealt with are galvanic corrosion, causes of stress corrosion cracking, effects of vibration, and steam erosion-corrosion.

Time Saving Tables

The new book carries many tables, data and formulas. It covers heat transfer rates and general specifications. Especially valuable is the comprehensive table listing in compact form the comparative properties of standard condenser tube alloys including such items as alloy composition, mechanical properties, physical constants, thermal and electrical data, fabrication properties and specification numbers.

Considerable space deals with the care, handling and storing of condenser and heat exchanger tubes; methods of installation; cleaning and removal of old tubes.

A portion of the book is devoted to various Duplex tubes combinations of ferrous and nonferrous alloys to offset the effects of two different corrosive media which may exist simultaneously on the outside and inside of the tubes. The applications of Duplex Tubing in industry are rapidly increasing.

How to Obtain a Copy

This valuable book can be of great help to engineers concerned with the selection of tubes, design, operation and maintenance of all types of condensers and heat exchanger equipment. You may obtain a copy by writing to Bridgeport Brass Company, Bridgeport 2, Connecticut, on your company stationery. If you have a corrosion problem, or require condenser and heat exchanger tubes, contact your nearest Bridgeport district office. Our Technical Service Department will be glad to help you select the correct alloy or Duplex Tubing combination which will give you the best service life. (101)

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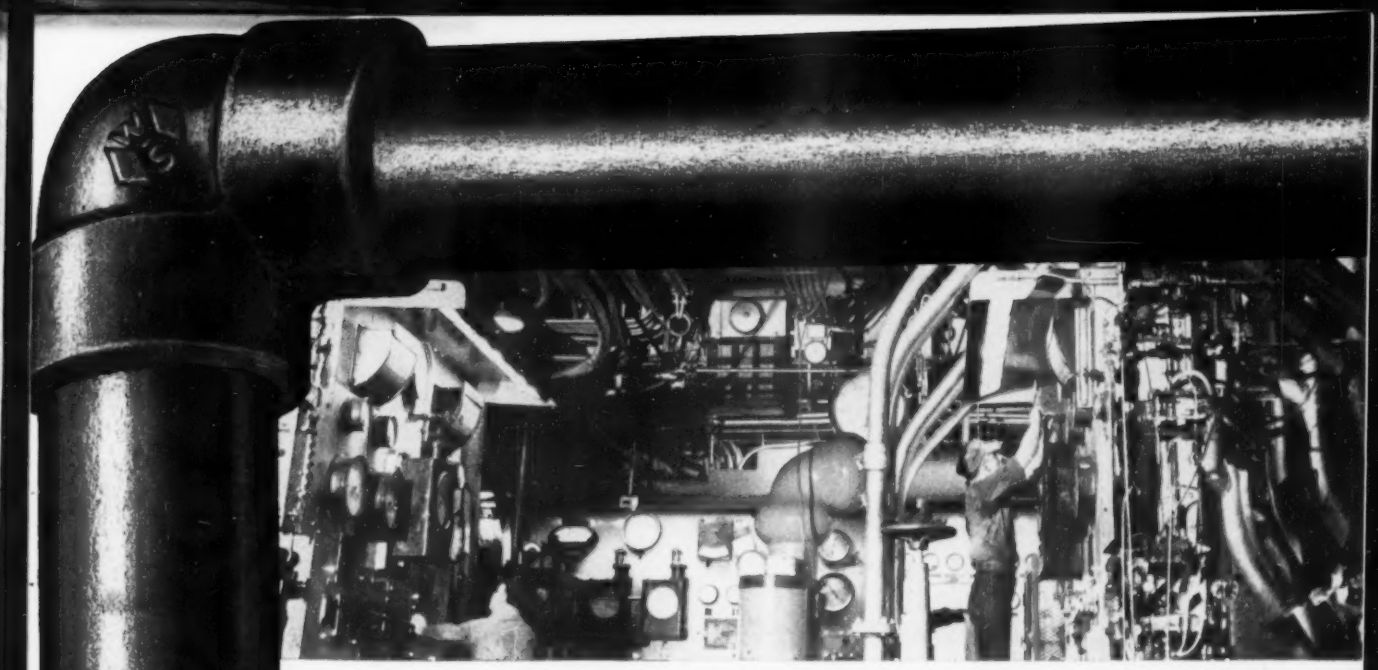

STOP COSTLY PIPE-LINE FAILURES

No one knows better than you the increasingly high cost of unscheduled outages due to pipe-joint failures. But do you know just how far it is possible to go toward *eliminating* such failures throughout the life of your piping systems? The answer to this critical problem in production and maintenance costs is FORGED STEEL FITTINGS by the pioneer firm of Watson-Stillman—consultants and suppliers to *all* major industries concerned with pipe joining and maintenance.

Watson-Stillman fittings are FORGED for maximum strength, toughness, and resistance to corrosion, vibration, and shock. More uniformly precise in all dimensions, they are the modern go-between wherever pipes meet permanently.

Leading Refineries, Chemical Plants, Public Utilities, Refrigeration and Industrial Plants throughout the world stay on stream at lowest cost-per-year with the famous Double-Diamond Fittings by Watson-Stillman. Write for literature.

Screw-End and Socket-Weld Types

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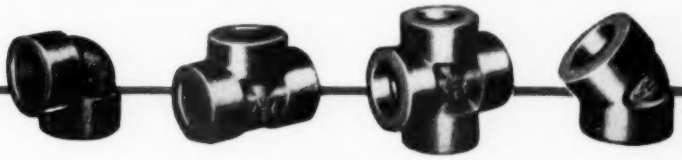

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

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NO SEAT TO SCORE, WEAR,
CLOG OR LEAK • NO SEAT TO
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TO SCORE, WEAR,
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SCORE, WEAR,
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● *Yarway Seatless Blow-Off Valve showing balanced sliding plunger in closed position. For pressures to 400 psi. Available singly or in tandem, angle or straightway.*

BEHIND IT...*AN ENGINEERING REASON*

More than 16,000 boiler plants use Yarway Blow-Off Valves. Why?

Because behind each valve is an engineering reason.

Take the Yarway Seatless Blow-Off Valve for low and medium pressure boilers. *It has no seat to score, wear, clog or leak.* The unique balanced sliding plunger eliminates a common source of blow-down valve trouble. Many boiler shut-downs are saved... power interruptions avoided and... production speeded.

Specify Yarway Blow-Off Valves on your boilers—*including package units*. You'll be rewarded by dependable, trouble-free blow-down service.

Write for Yarway Blow-Off Valve Bulletin B-425 (pressures to 400 psi) or Bulletin B-433 (pressures to 2500 psi).

YARNALL-WARING COMPANY
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YARWAY | ***blow-off valves***

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Monotube Comes to U.S.

Combustion Engineering, Inc. makes license agreement to build and market Sulzer's Monotube steam generator, used in many high-pressure European plants. This will supplement Combustion's studies looking toward development of 5000-psi, 1200-F boilers for further advance in power economy

COMBUSTION Engineering, Inc., it is announced by Joseph V. Santry, chairman, has consummated a license and technical assistance agreement with Sulzer Bros., Ltd. of Winterthur, Switzerland, one of Europe's outstanding manufacturers of boilers and power plant equipment. Under this agreement, Combustion Engineering will manufacture and market "Sulzer Monotube Steam Generating Plants" which long have been built by Sulzer Bros. and of which a great many high pressure installations have been rendering satisfactory service in European countries for many years.

European H-P Progress

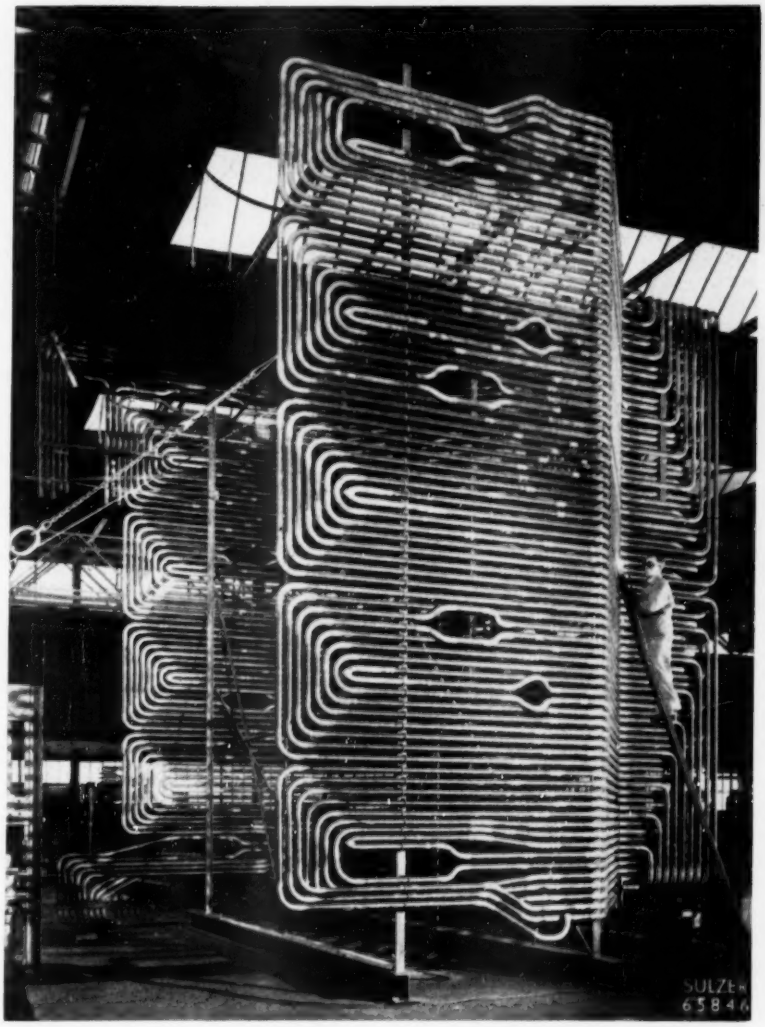
This agreement, Mr. Santry said, represents the culmination of several years' investigation of European development in the field of high steam pressures and is particularly significant at this time because of the interest in pressures above the so-called "critical pressure" of 3200 psi. At pressures above this point, Mr. Santry explained, conversion of water to steam is instantaneous and skips the intermediate bubbling phase which characterizes the transition at pressures below critical.

Highest pressure boiler in the world thus far is one recently placed in service by Combustion Engineering at the Kearny, N. J., power station of the Public Service Electric & Gas Co. This boiler has a design pressure of 2650 psi and its steam temperature of 1100 F is also the highest used in any power station to date. With this pressure and temperature, the new Kearny Station is expected to set a world's record for power station economy, producing electricity at an average heat rate of about 9000 Btu per kwh.

Must Pass Critical Pressure

In order to achieve further appreciable gain in power station economy, it will be necessary to go beyond the critical pressure point; and, with the special designs of boilers and turbines that this will require, it will be possible to increase steam pressures far beyond the top pressures used up to now, with steam temperatures 100 deg above the present high.

Mr. Santry said that his company now is prepared to build boilers for 5000 psi pressure and 1200 F steam temperature, and that still higher pressures and temperatures are a distinct possibility. With such steam pressures and temperatures, substantial increase over the best present-day efficiencies of power generation will be attained. With the predicted power consumption of the country doubling in the next 10 years, it is important that power installations be designed for the highest possible efficiencies in order to conserve our fuel resources.



View of assembly, at Sulzer plant in Winterthur, Switzerland, of tubing for combustion chamber of monotube steam generator for capacity of 140,000 lb per hr of steam at 1930 psi. In these monotube units, tubing of combustion chamber, evaporating section, superheaters and economizers forms one continuous tube; feedwater enters at one end and leaves as steam at other end; there is no boiler drum; unit has forced circulation. Many steam generators of this type have been installed in European plants

Mr. Santry stated that Sulzer Brothers' years of specialization in boiler designs for high steam pressures and their development and research in this field would be a valuable supplement to the design studies his company has been making for some time past looking toward the development of boilers for pressures in the 5000 psi region, to advance the art still further.

Fig. 1. Engineers study equipment and coal

How to Buy Coal for the Small Industrial Plant

By M. H. CHARLES

Amid maze of different coals available, small plant coal buyer needs to know how to analyze them for performance and economy. Here are the factors he must take into account

MANY DIFFERENT varieties of coal offered today, at what appear to be attractive prices, often may be a source of bewilderment to the buyer of coal for the small and medium-sized power plant. Yet prudent analysis of available coals from the point of view of performance and economics frequently may lead to appreciable savings. This is true particularly in areas that have to import all their coals from a variety of different fields.

Assume that the buyer is buying coal for an existing boiler plant rather than a new plant under construction. Design of the equipment and the duties it has to perform will set certain definite limitations to the grades of coal it may use. Frequently, coals are rejected because the firemen "do not like" the coal or because they claim there are "too many fines" or "too much ash" in the coal. Hearing this, the buyer tacitly assumes the coal to be unsatisfactory.

In point of fact, however, the coal may well meet all load conditions and, in addition, be more economical. A little more effort in adjusting combustion conditions and handling additional ash is not sufficient reason for condemnation.

Fuel Specifications A Must

First question is: What coals will carry the steam load and what coals will not? The answer forms the basis of any systematic buying policy. It is entirely a technical problem and requires careful analysis. It may even pay smaller plants to call in outside professional help. The general power or plant engineer cannot, in all fairness, be assumed to be a combustion expert in addition to the many other fields he is expected to master. Many reputable coal companies will offer the assistance of their fuel engineers. Independent consultants also are available.

The first part of the problem consists essentially of (a) establishing broad limiting specifications on desirable coal characteristics for the plant and (b) providing the buyer with guidance as to the description of coals that may fit into the picture.

From the point of view of combustion, five design features set limitations to eight important combustion characteristics of coal:

Design Features	Coal Characteristics
1. Type of combustion equipment	1. Minimum ash-softening temperature
2. Design capacity in relation to steam load	2. Sizing
3. Furnace volume	3. Coking index
4. Boiler design, especially auxiliary heating surfaces	4. Minimum heat value, Btu
5. Method of ash removal	5. Grindability
	6. Volatile content
	7. Sulphur content
	8. Ash content

This table necessarily is somewhat oversimplified, since all these factors are to a greater or lesser degree interrelated, but it does give an indication of the more important relationships.

Analysis of Coals

Such a study, used together with past experience, will give broad guidance as to the coals that may be used. Note that ash content is listed last for, contrary to general opinion, it plays or should play a relatively minor role in this study. As long as the ash can be removed regularly so as not to affect the burning rate, its effect will be merely additional to labor cost, if any, in handling it.

It is the cost per million Btu or, ultimately, the cost per 1000 lb of steam produced, that matters. Total non-combustible content, consisting of ash plus moisture, will be reflected in these figures. Thus a coal with an ash content of 9 per cent may prove lower in cost than one with an ash of 7 per cent.

To illustrate the factors to be considered, let us compare, as in the table, the coals that might be available to a Midwestern purchaser

The accompanying table gives a summary of the principal coals available from the Midwestern coal fields. It shows their heat value, ash content, ash-softening temperature, and typical delivered cost. Ash varies between 7.6 per cent and 9.0 per cent with the exception of Mine 2 — Field C, the ash content of which is only 5.8 per cent.

There is little consistency in the order of ash-softening temperatures. It is this characteristic which frequently limits the choice of coals. Those with the highest ash-softening temperatures are produced by Mine 4 — Field A and Mine 1 — Field B.

Cost: — A major item in the determination of the delivered cost of coal is the freight. The buyer is, therefore, inclined to buy a coal located nearer to his plant in order to keep down transportation cost. This item and the price are, of course, based on weight. However, steam is not produced by the weight of coal but by its heat content.

The cost per ton of coal means little — 25 per cent of it may be non-combustible. The cost of the amount of heat units bought is of more significance. As most buyers know, coals are compared on a basis of the number of British thermal units stored per pound of coal. Knowing the cost per ton, one may easily determine the cost of the heat units bought, generally, in cents per million Btu.

For example, consider coal from Mine 4 — Field A at a heat value of 12,140 Btu per lb and a delivered cost of $7.57. The heat cost would be:

$$\frac{7.57 \times 1{,}000{,}000}{2000 \times 12{,}140} = 31.2 \text{ per million Btu}$$

From the table, it is seen that delivered costs of the coals shown vary from 30.6 to 33.8 cents per million Btu. The lower figures are due to the methods of preparation: coal from Mine 1 — Field C is raw and from Mine 2 — Field 6 is washed but not heat-dried during the winter.

Coal Size: — There is available a variety of sizes of industrial coals. The top size is determined almost exclusively by the type of firing equipment. Thus, underfeed stokers usually take 1½ in. top size mechanical spreaders, 1 or ¾ in. top size; pneumatic spreaders may handle top

sizes from 1 in. to as low as ⅜ in.

It is in the bottom sizes where many variations are offered and which influence greatly the price of coal. Generally speaking, the larger the bottom size and the lower the percentage of fines, the higher is the price of the particular preparation.

Fines are usually considered sizes below ⅛ in. As their amount is increased, the price becomes lower; but the following effects may be experienced:

More clinkering due to uneven air distribution and higher ash content.

Uneven feeding due to segregation of larger pieces and fines.

Loss of fine coal through air spaces of chain grate.

Greater tendency to cake on underfeed stockers.

Dust nuisance when handling coal.

Increased fly-ash and cinder emission, particularly on spreader stokers. (The minus 20 mesh coal stays in suspension in spreader-firing without reaching the grate.)

Greater tendency to hold surface moisture.

On the other hand, fines are beneficial on some combustion equipment. On large underfeed stokers they help seal the feed pipe against smokeback; and on spreader stokers they allow some combustion to take place in suspension.

A compromise must be reached, therefore, between these conflicting factors. The most popular bottom size is 28 mesh, although 10 mesh and even ⅛ in. have been found economical in industrial plants. Coal price alone should not be the only factor, but the over-all cost and plant performance should be considered carefully.

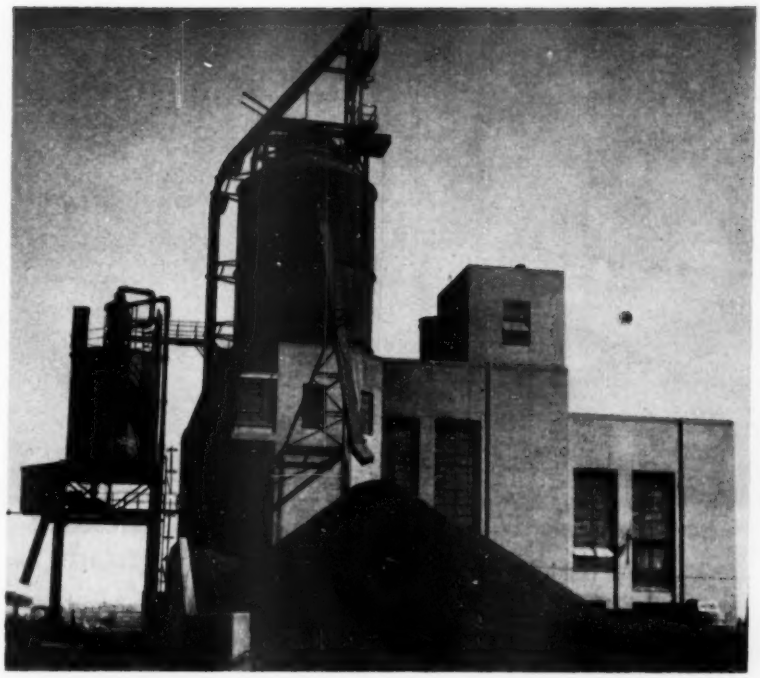


Fig. 2. Typical small industrial boiler plant, equipped with modern coal and ash handling equipment and coal storage area. This is the type of plant in which careful evaluation of coal is often sorely needed

Coal Preparation

Next item the buyer should ascertain is the method of preparation used by the coal companies he is considering. There are essentially three methods of preparing coals:

1. **Raw Coal:** — Here the coal is merely sized by screens, and little effort can be made to maintain uniform quality. The screenings will contain all the fines in the coal mined. Coal quality may vary from car to car, depending on mining conditions.

2. **Washed coal:** — Most modern methods of cleaning coal employ water to separate coal from slate, pyrite, and other high ash particles. A maximum of the impurities is removed and the ash content is maintained constant. Where screenings are washed, the very fine sizes, below 28 mesh or 48 mesh, are removed in the process. By discarding impurities, and by additional mixing of clean coal, the coal becomes a uniform product.

3. **Air-cleaned Coal:** — The coal is cleaned by means of high-velocity air which also "de-dusts" the coal; i.e., removes the very fine sizes. This is a dry process, therefore is preferred by some coal users for winter shipments.

Small and medium-sized plants do not have elaborate coal handling and combustion equipment available. It is important for them to have a product which offers uniform consistency and easy handling during all times of the year.

Table showing characteristics of coals that might be available to a Midwestern coal buyer, for selection of most economical coal. Ash softening temperature is characteristic that often limits choice of coals

Field	Preparation	Heat Value Btu/lb	Ash %	Ash-Softening Temp., F	Delivered Cost $ Per Ton	Cost, Cents Per Million Btu
Field A						
Mine 1	washed (heat dryer available)	10,510	7.6	2145	7.10	33.8
Mine 2	"	10,880	9.0	2115	6.99	32.2
Mine 3	"	11,170	9.0	2070	7.24	32.4
Mine 4	"	12,140	8.3	2200	7.57	31.2
Field B						
Mine 1	"	11,050	8.4	2265	6.85	31.0
Mine 2	"	11,260	8.6	2210	7.00	31.1
Mine 3	air-cleaned	11,680	7.8	2135	7.14	30.6
Field C						
Mine 1	raw	11,630	9.9	2030	7.19	30.9
Mine 2	washed (no heat dryer)	12,790	5.8	2150	7.99	31.3

Freezeproofing

An important item is the provision made by the coal producer to ensure the absence of frozen cars during the winter months. The moisture in the coal causing the freezing is, of course, surface moisture. Coal analyses usually do not differentiate between inherent moisture and surface moisture, so that the moisture figure given as part of the proximate analysis gives little indication as to the risk of freezing.

Wet washing coal naturally increases very considerably the percentage of surface moisture. Mechanical drying, such as centrifuges or vacuum filters, removes most but not all of the surface moisture on the coal. Many mines, therefore, have been equipped with thermal dryers to remove surface moisture almost completely. Large volumes of heated air are used to furnish heat for evaporation and removal of the water vapor.

There still remains the hazard of rain and subsequent freezing in transit; but if the coal was originally dry, the extent of freezing should be

Fig. 3. Firing aisle, new stoker-fired boiler plant serving the Capital City Products Co., Columbus, Ohio

relatively small. In some cases, it may be advisable to provide oil treatment in addition to heat drying. The film of oil is thought to seal the pores of the coal and so shed any subsequent moisture due to rain or snow. (See July issue, page 70; Treated Coal Solves Silo Problems for A. B. Dick Co.)

Another arrangement may be to purchase double-screened coal during the severe winter months. A coal that contains little or no fines, say nothing below ¼ in., holds little surface moisture and will not freeze as hard as wet screenings.

Addition of calcium chloride or common salt to coal for freezeproofing is practised by some mines; and, except in extremely cold weather, these chemicals are effective. Because they promote corrosion of metal parts with which the coal comes into contact, washing of conveyors, chutes, and other coal-handling equipment at regular intervals is recommended.

Raw coal or "de-dusted" coal contains only its natural moisture. Some people claim that it has a natural tendency to shed moisture in contrast to washed coals, which tend to absorb it, but there does not appear to be conclusive evidence one way or another.

Storage

Midwestern coals may be stored without great risk of spontaneous combustion, provided the screenings are packed down tightly so as to limit the movement of air through the pile. Not many small plants have the equipment or manpower to do this. Here it generally is preferable to buy a coal with good storing quality, usually a coal of low sulphur and moisture contents. If there is any danger of spontaneous combustion, however, the best policy for the small plant is to use and replace its stockpile several times a year.

Depending on his coal consumption, the buyer will ascertain the capacity of the mines from which he intends to buy and the reliability of the supplying company. Additional resources of the producing company also should be investigated in case of breakdowns or strikes. Some users save money by purchasing a lower-quality, lower-cost coal during the summer when steam demand is low, and then obtaining a higher-quality, higher-cost coal during the winter when the lower-cost coal could not carry the steam load — and, of course, the load *must* be carried.

Railroad: — The shipping point, railroad, and routing from the mine also should be investigated. A direct haul from the mines to the plant is a decisive advantage for ensuring regular shipments.

Plant Tests Final Proof

Once a broad policy on usable coals has been accepted, the next step comprises plant tests. It is obviously impractical to test every available coal that fits into the specifications. A sound policy is to test a representative coal from each of the coal fields that offers a product with the desirable characteristics.

Tests are run to determine suitability and economy of the various coals. Suitability usually may be shown in one or two days' run covering the heavy steam load during the day and the lighter load by night. However, the economy of a coal takes into account many factors and requires an extended test period.

Cost per 1000 lb of steam produced is the ultimate figure used as a yardstick for comparison. This figure should include not only the direct fuel cost but also labor cost incurred in unloading and handling, in cleaning and removing ashes and cinder, and all maintenance cost attributable to the coal under test. Generally, three weeks' test run will give fairly reliable data.

At the end of the testing period, a summary is made of the over-all results, showing the cost of producing steam, responsiveness to load changes, nature of ash, and the like.

Final Arrangements

A decision then must be made as to the number of coals or supplies desirable. Here are some of the more important factors that enter into this consideration:

1. **Total Tonnage:** — Many purchasing agents deem it prudent to have two suppliers of a coal from the same field. For larger consumers, three or four suppliers may be advisable. On the other hand, buying from a single source may establish a closer relationship between shipper and consumer which may prove valuable in an emergency.

2. **Supervision and Controls:** — Where the operating supervision or available combustion controls are limited, it is not good policy to buy different types of coal. If two suppliers are to be selected, care should be taken to ensure that both coals are similar in source, preparation, and combustion characteristics. The reason, of course, is that different coals require different methods of burning. In smaller plants, the time required for these adjustments is neither available nor warranted.

3. **Supplying Company:** — The companies offering the coals of lowest steam cost may not offer all the features the buyer desires, such as freezeproofing, diversity of resources, etc. It is good policy in such a case to give at least some portion of the tonnage to the higher-cost coal supplier. The additional cost may be regarded as an insurance for emergencies — and emergencies can be costly.

4. **Testing:** — In making up their buying schedule for coal, several companies reserve a percentage, say 20 percent, for test purposes. This tonnage is to be filled by occasional test orders of coals which are offered in the course of a year and appear attractive.

Should coal be bought in the open market or on contract? The implied assumption in this present article has been that coal was to be bought on contract; and most companies, large or small, prefer this. It gives them a certain assurance of supply and saves recurrent time and work in making new decisions on orders.

However, in times of plentiful supply of coal, buying part or all of the tonnage in the open market may be very advantageous. In this case, a thorough test survey of usable coals is doubly important. Knowing the limiting specification, or better, a large list of coals already tested and found satisfactory, the buyer can buy from month to month and take full advantage of the market.

By taking account of the factors discussed here, the coal buyer can obtain for his small industrial plant the coal that makes the cheapest steam.

Waste Heat to Make Steam at White Pine Smelter

PLANS TO RECOVER vital copper in one of the richest undeveloped deposits on the North American continent called for a specially designed boiler to utilize what otherwise would be waste heat from a copper reverberatory furnace. The boiler, designed and being built by the Babcock & Wilcox Co., will supply steam to a turbine generator to furnish power for the projected development.

The scene of this spectacular operation is the White Pine copper smelter 18 miles southwest of Ontonagon, Mich. Explorations conducted over the past 15 years by the Copper Range Co. of Boston determined there is a sufficient ore body to produce copper for the next 50 years. The company, at the request of the DMPA and assisted by an RFC loan of $57,000,000, currently is constructing the necessary facilities to recover, process and ship fire-refined copper from the site. This work is being done by the White Pine Copper Co., a wholly owned subsidiary of Copper Range.

The ore mineral is mainly chalcocite, a cuprous sulfide (CU_2S). The total ore reserves amount to 309,000,000 tons averaging 21.3 lb of copper per ton.

Boiler of Special Design

The boiler, which will be about six stories high, is to be in line with and following the reverberatory furnace in which the copper ore is melted, as shown in the drawing.

The gases or products of combustion, heavily laden with slag particles and dust, leave the reverberatory furnace at a rate of approximately 143,000 lb per hour at a temperature of 2600 F, entering, first, the waste heat boiler furnace, then passing through the superheater and convection section of the boiler.

The hot slag particles will fuse on any surface with which they come in contact, especially if the surface is hot. To cope with this problem, the waste heat boiler was designed specially with tube-to-tube water-cooled wall radiation chamber, widely-spaced platen-filled chamber and superheater chamber, and a cross-flow convection boiler section.

Heat absorption of the water-cooled furnace walls and the water-cooled platens reduces the temperature of the incoming gases 400 to 500 F before they enter the superheater chamber. Thus the suspended slag particles are cooled to a dry ash, which drops to the furnace hopper thence into hoppers under the boiler, from which it is returned to the reverberatory furnace for retreatment to reclaim the copper.

Provisions for Cleaning

The parallel, instead of the usual staggered, tube arrangement is intended to make cleaning more effective. This is accomplished by automatic telescopic soot blowers, located in lanes between the platens, superheater and boiler convection sections, periodically blowing high-pressure steam through nozzles across the boiler.

This arrangement prevents slag accretion on tubes which otherwise would necessitate hand lancing, a time-consuming and expensive operation. Besides, this arrangement insures continuous operation.

To minimize draft loss and insure against sulfurous gases leaking into the boiler from where men work, there will be a single-pass horizontal cross gas flow arrangement from the reverberatory furnace outlet through the waste heat boiler and to the balloon flue inlet.

Using this waste heat from the reverberatory furnace instead of fuel for the generation of steam, the waste heat boiler recovers about 50 per cent of heat in the fuel originally supplied to the reverberatory furnace.

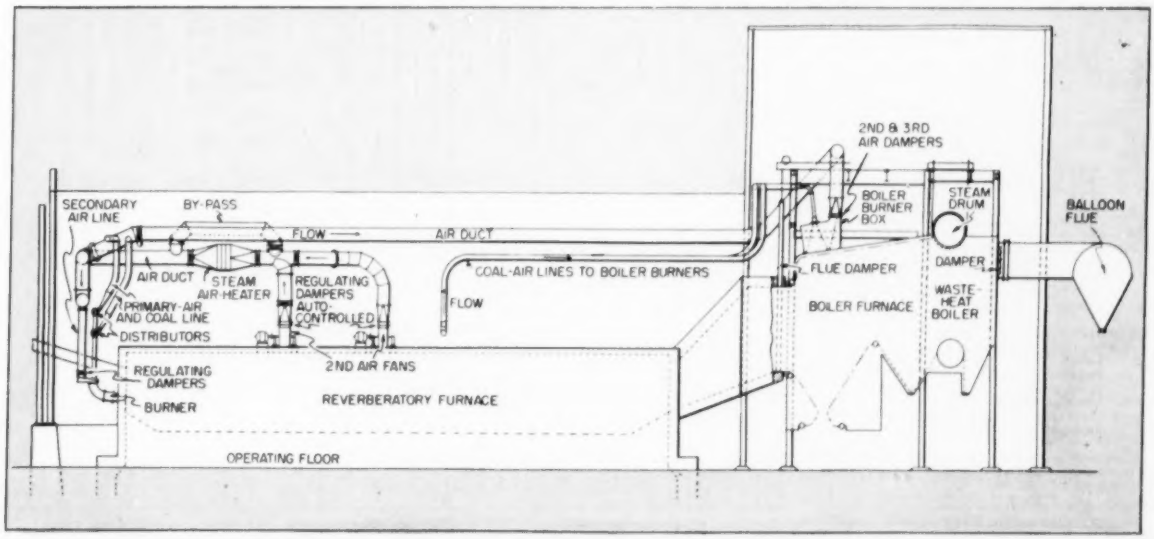
The boiler is designed to generate steam at 885 psi, at 920 F at the superheater outlet. The steam is used not only in the power plant, but a portion is used to preheat combustion air, by means of steam air heaters, for the reverberatory furnace.

Continuous Steam Production

Whenever the reverberatory furnace may be shut down for repairs, the boiler, by a special arrangement, can be fired with pulverized coal.

A pulverized coal system, including distribution and burning equipment, also will be installed. There are three pulverizers, two of which normally will fire the reverberatory furnace. The third, through a system of inter-connected piping, will serve as a standby unit to insure uninterrupted operation and also will supply intermittently pulverized coal to a storage system, from which it will fire a holding furnace, a refining furnace and a copper converter.

An innovation in the smelting industry is the completely automatic control system, which will permit firing of the reverberatory furnace from a central control center. From the same push-button panel, engineers can operate the waste heat boiler, coal pulverizers, raw coal conveyors and the pulverized coal distributing system.



General arrangement of equipment for pulverized coal firing of the reverberatory furnace and waste heat boiler at the new White Pine copper smelter

More On Metal Coatings

In our previous issue the author discussed how to select the best metal or protective coating to prevent corrosion. Here he continues, discussing corrosion effects

By L. G. JONES

PLATED, or electrodeposited metal coatings, have not been popular for long outdoor corrosion resistant life when one speaks in terms of 40 years. One of the great advantages of hot dipping steel parts into other molten metals has been the alloy which forms at the junction of the dissimilar metals; this alloy is not only nonpermeable but may even be more resistant than either the bare metal of either the coating or the basic steel. The most important quality, however, is the non-porosity of the hot molten coatings which prevents infiltration of moisture which would permit galvanic corrosion and chemical attack to start and grow at an accelerated rate. Plated coatings have not these advantages and one need only examine the normal external plating on automobiles to see the short life of average porous coatings of corrosion resistant nickel and chromium. Apart from the weakness of plating, both these noble metals are cathodic to iron and do not give the protection afforded by zinc, cadmium, aluminum and other metal coatings that are anodic to iron.

Even if the protective effects of these metals were equal, the molten coating would run an average of 0.005 in. thick while the electrodeposited coatings might be only $\frac{1}{10}$ of that thickness, which is below the minimum for the shortest expected life shown in table VI.

In the electrical power industry, the use of copper and aluminum together is increasing. Action between copper and aluminum produces a high resistance oxide film. Cadmium plating copper prevents this high resistance film; this is done by many manufacturers. Hot dip tinning would be preferable because: 1. It forms a tight impervious coating, 2. It forms a better bond with the copper, 3. Tin is about half way between the galvanic potentials of aluminum and copper and so reduces the oxidation between those two metals. Although the tin is a poorer conductor of electricity than aluminum or copper, this disadvantage is more than compensated by its action in maintaining clean tight contacts between the metals. Rust inhibiting greases are

Table VIII. Shows the effects of various corroding agents normally encountered in industry on some of the more commonly-used industrial metals and alloys

Class of Material	Nominal Composition							Atmospheres		Water					Oxidation Resistance Max. Safe Temp. °F.			Fruit, Vegetable Juices	Dairy Products
	Carbon	Chromium	Nickel	Silicon	Copper			Sea Shore	Industrial	Domestic	Mine	Sea	Saline with H_2S	Brackish with Cl	Wet Steam	Oxidizing Gasses	Reducing Fuel Gas	Sulphur Rich Gas	
Ingot iron or wrought iron	0.03				0.08			P	P	P	P	PF	P	F	F				P
Low C steel	0.10				0.08			P	P	P	P	F	P	F	F				P
Low C copper steel	0.10				0.25			F	G	P	F	F	P	F	FG				P
Hot galvanized iron & steel								G	G	F	F	G	F	F					P
Colorized iron & steel								G	G	P	P	P				1650	1650	1650	
Gray cast iron	2.8 graphite, 0.7 combine cabon							F	G	F	F	F							P
High silicon iron	0.60			14.25				E	E	E	G	E							G†
Nickel cast iron	3.30		3.50	1.50				F	G	P	P	F							
Chromium cast iron	2.50	25.00		2.00				G	G	G	G	FG				1800	1800	1800	
Ni-Cr-Cu cast iron	3.00	2.00	14.00	1.50	6.00			G	G	G	G	G	F	F	G	1200	1200	1200	F
Nickel steel: Low Ni	0.18		3.00					F	F	F	P	F							P
High Ni	0.30		28.00					G	G	G	FG	E							F
Chromium steels: 5% Cr	0.15	5.00						F	F	F	P	P	P	P	F	1200	1200	1200	P
12% Cr	.10 max.	12.00						G	G	G	F	F		F	G	1400	1400	1400	G
17% Cr	.10 max.	17.00						G	G	G	G	G		G	G	1600	1600	1500	G
17% Cr, 4% Mo	.10 max.	17.00				Mo 4.0		G	G					G	E	1900	1900	1800	E
27% Cr	.50 max.	27.00						G	G	E	G	G		G	E	1500			G
Silcrome, (8% Cr, 3% Si)	0.45	8.25		3.50				G	G	F	F	F	F	F	F				F
Stellite	3.0 max.	30.00				Co 55.0	W15.0	E	E	E	E	E	E	G	E	2000	2000		E
Cr-Ni steels: 8–20	0.20	8.00	20.00					G	G	G	G	G				1600	1600		
18-8, 4% Mo	0.15	18.00	8.00			Mo 4.0		E	G	E	G	G	E	E	E				
18-8	0.10	18.00	8.00					E	G	E	G	G	E	G	E	1550	1550	300 to 1300	G
18-12	0.10	18.00	12.00					E	G	E	G	G							
18-35	.50 max.	18.00	35.00	1.00				E	G	E	FG	G				1900	1900	1900	G
25-12	.25 max.	25.00	12.00					E	G	E	G	G	E	G	E	2100			G
26-24	.15 max.	26.00	24.00	3.00				E	G	E	G	G	E	G	E	2100	2000		G
Commercially pure Ni			99.00					E	G	E	G	E	G			1300	2000	P	G
Nickel alloys: Monel metal	0.15		67.50	0.50	28.50	Mn 1.50		E	G	E	PE	E	G		E	900	2000	P	G
Nichrome, 60-15	0.12	15.00	60.00					G	G	E	G	G				1475 to 2100		P	G
Inconel, 14% Cr		14.00	80.00			Fe 6.0		G	G		G	G				2000	2000		E
80% Ni, 20% Cr		20.00	80.00					G	G	E	G	G							G
Hastelloy		14.00	58.00			Mo 17	W 5.0	E	E	E	G	E	E	E	E				E
Commercially pure Cu					99.90			G	G	G	FG	G							FG
Copper alloys: Red brass					85.00	Zn 15.0		G	G	FG	FG	G							FG
Tobin bronze					60.00	Zn 39.2	Sn .75	G	FG		F	G	F						
Phosphor bronze					95.00	Sn 5.0	Zn 1.5	G	FG		F	G							P
Silicon bronze				3.00	95.00	Mn 1.0 or	Sn .5	G	G		FG	G							G
Aluminum bronze					90.00	Al 9.0	Fe .5	G	G		FG	G							FG
Nickel silver			20.00		75.00	Zn 5.0	Ni .5	G	G		G	G							G
Admiralty metal					70.00	Zn 29.0	Sn 1.0	G	G		FG	G							FG
Commercially pure Al						Al 99.20		F	F	FG	P	F							G
Commercially pure Sn										E									G
Commercially pure Pb					0.06	Pb 99.90		G	G	FG	G	G							P

E = Excellent; almost unlimited service G = Good, will give good service F = Fair, only to be used in temporary construction P = Poor

Courtesy Metal Progress Compiled 1933 by Jerome Strauss, Vanadium Corp. of America

being used increasingly to reduce corrosion of electrical contacts. Clean contacts mean less heating of the joints when carrying heavy currents.

Galvanizing vs Cadmium Plating

The author has done some work in comparing the life of hot dip galvanizing, cadmium plated, new and salvaged old bolts. Random samples of double arming and machine bolts were selected from among

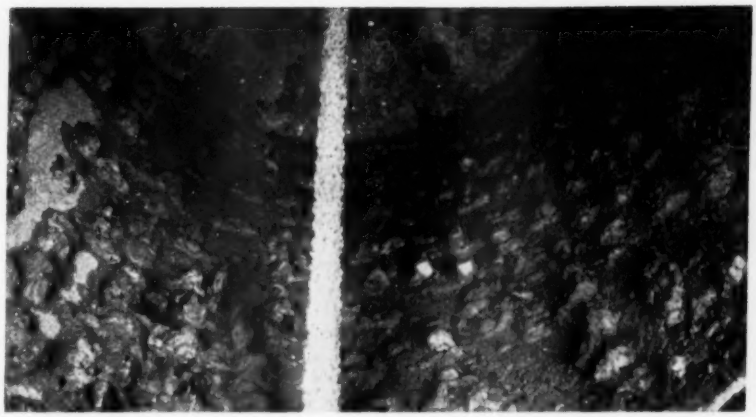
1. New hot dip galvanized stocks of bolts with rolled threads
2. Samples of new cadmium plated double arming cut thread bolts
3. Old salvaged hot dip galvanized bolts with roll threads which had been cadmium plated.

These bolts were suspended in a corrosion testing humid oven at 100 F and 100 per cent relative humidity for 100 days. The average thickness of coatings on these samples measured as follows:

	Thickness of Coating in Inches	
	Bolt Body	Nut Surfaces
New galv. bolts	0.005	0.005
New cad. plated bolts	0.0005	0.0002

These results confirmed the previous observations, that the heavier hot dip galvanized surfaces resist corrosion better than the thinner cadmium plating. Oddly enough, cadmium plating over the galvanized zinc provided a coating that tested superior to new hot dipped galvanized surfaces.

In order to maintain a 40 year life for the entire pole assembly, electroplated hardware would require constant inspection to make sure the coating thickness was at least 0.0005 in., which is essential to long life. Without vigilance, these plating thicknesses may easily be thinner than 0.0005 in.



Part of an electric hot water heater tank showing also the badly eaten anodic magnesium protective rod

The National Bureau of Standards ran tests for 6 years, comparing zinc and cadmium plated steel using various types of plating solutions, exposures, atmospheres, etc. for industrial and rural areas (away from salt atmospheres). Their general conclusion shows that: 1. Cadmium coatings failed in 65 to 75 per cent of the time required for zinc coatings of a similar thickness; 2. Plated coatings of either metal with a minimum thickness of 0.0005 in. failed in a comparatively short time — a few years; 3. The protection provided is nearly proportional to the thickness of coatings.

This confirms findings shown in the previous tables and discussion; that hot dip galvanizing, which gives a heavier coating, results in longer life for outside exposure to rain, wind, sun, etc. Plating, on the other hand, is a precision coating and for inside operations, machine part protection, etc., it is more satisfactory.

Checking Thickness

Hot dipped metal coatings on threads which receive nuts require special care and skill, but since the threads are most subject to rusting, the heavier dip coatings are worth the extra trouble. Preece and drop tests, as listed in the ASTM and in Standard Laboratory Handbooks, provide simple ways to determine zinc coating thicknesses without laboratory equipment or skill. The magnetic thickness gages, now sold as standard laboratory equipment, give these thicknesses for non-metallic coatings of any type as well as inorganic paints, films, etc. very quickly and simply.

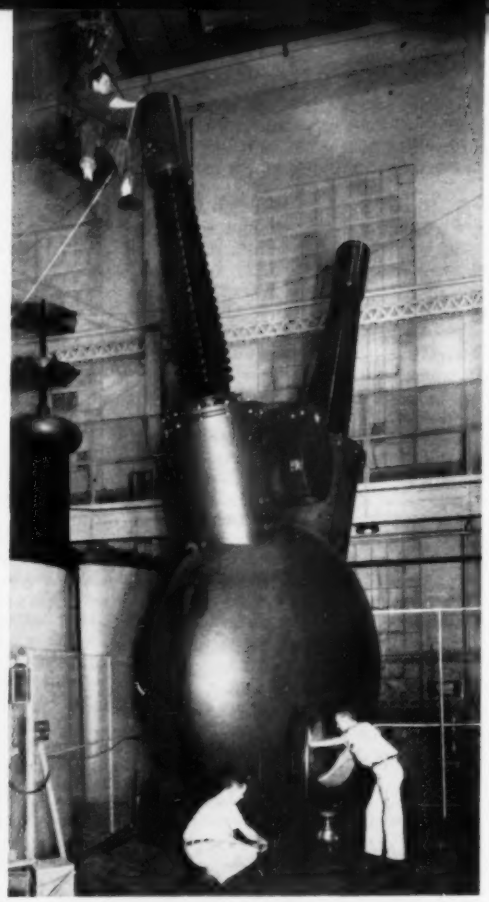
Low cost metallic coatings should not be relied on too much to increase the life of steel. Where such metal coated steel is used, it should be inspected frequently. As soon as the sheen is gone and paint adherence is assured, these surfaces should be properly painted to preserve the metal structure and ensure long life.

Continuation of table on opposite page showing the corrodibility of various common metals and alloys

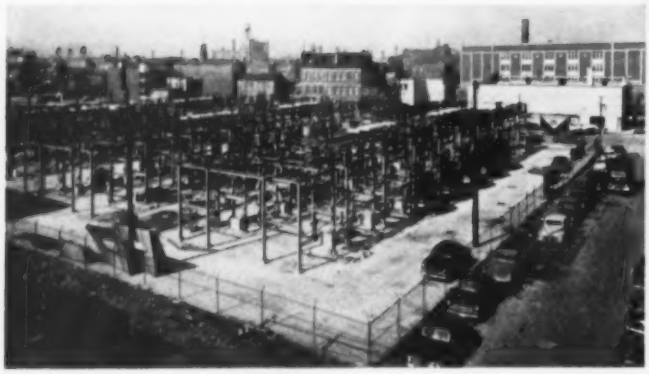
Other Food Products	Acids Moderate Concentration 5–15: HCl	H_2SO_4	HNO_3	Acetic	Phosphoric	Alkalies 1 to 20% Sol.	Alkalies Fused	Salt Solutions Medium Concentration: NH_4Cl	$MgCl_2$	$MgSO_4$	Hot Sulphite Liquor	Dye Liquor	Refinery Crudes Below 400°F.: Sweet	Sour	Class of Material
P	P	P	P	P	P	E		P	F	F			F	P	Ingot iron or wrought iron
P	P	P	P	P	P	E		P	F	F	P		F	P	Low C steel
P	P	F	P	P	P	G		P	F	F	P		F	P	Low C copper steel
P	P	P	P	P	P	F		P	P	PF					Hot galvanized iron & steel
											P	F	FG	FG	Colorized iron & steel
P	P	P	P	P	P	E	F	P	P	P	P	P	F		Gray cast iron
	F	E	E	G	G	E		G	G	G	P				High silicon iron
						E	FG				P	P	F		Nickel cast iron
															Chromium cast iron
	F	F	P	G	G	G	G	F	F	F	F	F	G	G	Ni-Cr-Cu cast iron
	P	P	P	P		E	G	P	F	F					Nickel steel: Low Ni
	F	G	P	P		E	G	F	E	E					High Ni
	P	P	P	P	P	G		P	P	F	P	P	G	G	Chromium steels: 5% Cr
G	P	P	G	G	F‡	E		G	G	G	P	F	E		12% Cr
G	P	P	G	E‡	P	E		G	G	G	F	F	E	E	17% Cr
															17% Cr, 4% Mo
E	P	P	E	F	G	G		E	E	E	GE				27% Cr
	P	P	E	G		G						PG			Silcrome, (8% Cr, 3% Si)
E	F	G	E	G	E	E		E	E	E	G	G	E	E	Stellite
	P	G	F	G	G	G	G				P		G		Cr-Ni steels: 8–20
	P		G	G	G	G		E	E	E	GE		E	E	18-8, 4% Mo
E	P	F	G	G	G	E	G	FG	E	E	GE	F	E	E	18-8
	P	F	G	P	F	G					G		E	E	18-12
	P	G	P	P	F	G	G				P				18-35
E	P	P	G	G	F	G	G	E	E	E	GE	G	E		25-12
E	P	F	G	G	G	G	G	E	E	E	E	G	E		26-24
GE	G	G	P	G	G	E	E			G	P	G			Commercially pure Ni
FG	FG	G	P	G	G	E	G	E		G	P	E	F		Nickel alloys: Monel metal
	F	F	F	G	G	G					P				Nichrome, 60-15
E															Inconel, 14% Cr
	F	G	P	G	G	E									80% Ni, 20% Cr
G	G	FG	G	G	E	E	G	G	G	G	E	G	G	G	Hastelloy
F	F	FG	P	FG	FG	FG					G	FG			Commercially pure Cu
P	P	FG	P	FG	FG	P					G	FG			Copper alloys: Red brass
	P	F	P	F	F	F					G	F	FG		Tobin bronze
F	P	FG	P	FG	FG	FG					G	FG			Phosphor bronze
	F	G	P	G	G	FG	P				G	FG			Silicon bronze
	P	FG	P	FG	FG	FG						FG	G		Aluminum bronze
	F	G	P	G	G	G						FG			Nickel silver
	P	FG	P	FG	FG	P						FG			Admiralty metal
G	P	P	P	F	P	P					P	F			Commercially pure Al
G	P	P	P								P				Commercially pure Sn
P	F	G	P	P	G	P	P					F			Commercially pure Pb

FG = F to G PE = P to E PG = P to G
† E at low and P at high concentration ‡ Below 50°C.

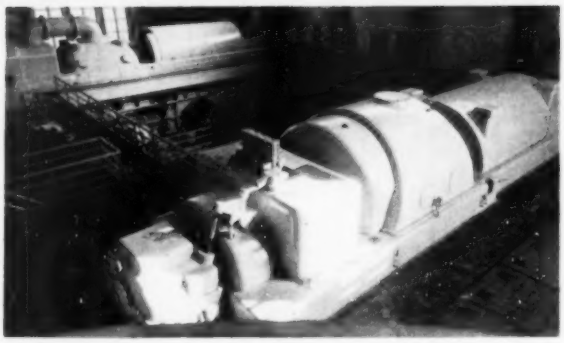
One of fifteen 330 kv, 15,000,000 kva interrupting capacity oil circuit breakers is readied for tests at G.E.'s Philadelphia plant. These breakers will be the first to have such a high interrupting capacity. Three units are required for each breaker installation in substations for a new 330 kv power network



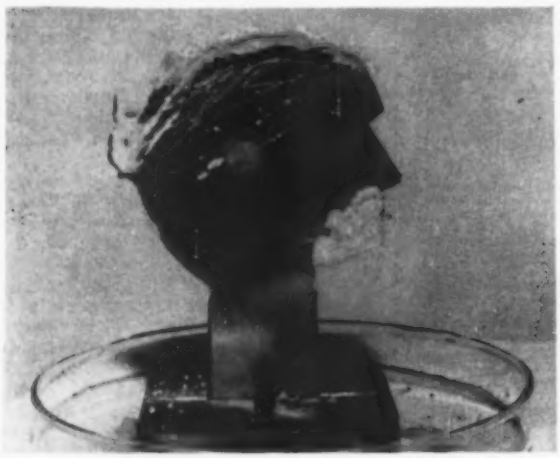
POWER ENGINEERING NEWS REEL

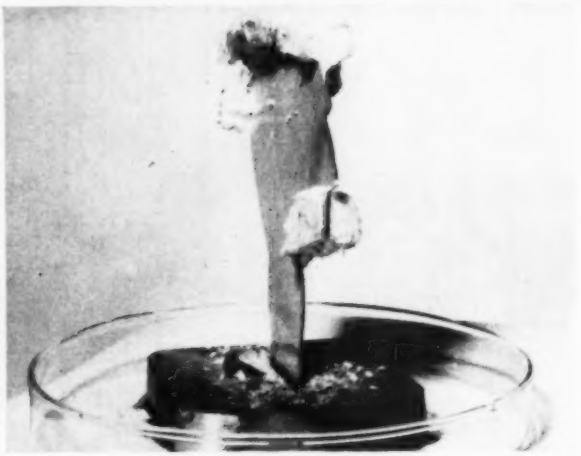


Replacing 19 "substandard" buildings southwest of Chicago's famous Loop, Commonwealth Edison's new Jefferson substation will be capable of supplying the electrical needs of an area equal to a city of 1,000,000 people when it is completed. The substation's control building is in the right background, beyond the switchyard which was activated late in May. Such installations may be effectively combined with civic programs dedicated to improved urban living



These turbine generators in Salem Harbor plant of the New England Power Company are now contributing 150,000 kw to the New England Electric System network. When operating at full capacity, the plant requires about 1350 tons of coal or 250,000 gal of oil per day. The plant, which cost $30,000,000, can supply the electric needs of eight cities as large as Salem



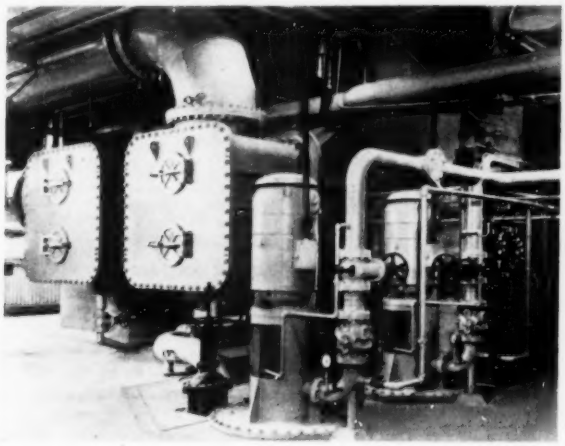


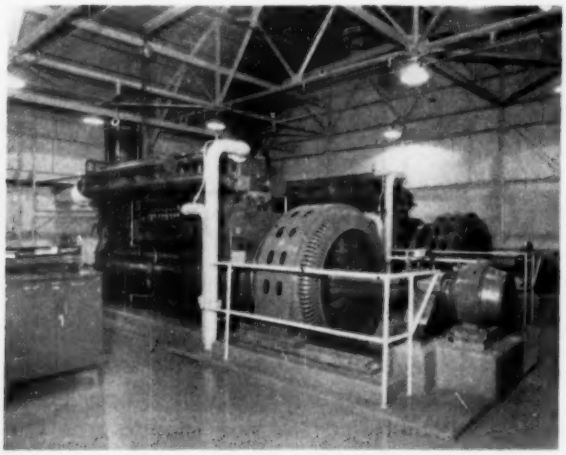
Not modernistic sculptures, but imaginative demonstrations of the result of scratching aluminum surfaces under mercury. Mercury inhibits the formation of aluminum oxide film, which normally protects the surface, and allows the uncontrolled growth of white hair-like oxide formations along the scratches

Looking somewhat like a tax collector, this particular monster was designed and built by an entire section of G-E's Distribution Transformer Dept. at Pittsfield, Mass. for a recent holiday parade. The "friendly dragon" is mounted on a fork truck and nine tow cars — has flashing red eyeballs, and it snorts

The new pumping plant of Indian Grave Drainage District, Quincy, Ill., cut operating costs from 37.4 to 24.6 cents per acre-ft with 375-hp diesels and new vertical, propeller pumps. The annual assessment of about $2.50 per acre increases crop values by $10 each year through good drainage

Below — rectangular design of Foster-Wheeler double flow condenser makes possible a 40 per cent reduction in over-all height and volume for the installation as compared to a conventional design. Height saving allows a similar reduction in turbine pedestal height and the cost of the building





The Northern States Power Co. now uses 27 diesels in 10 stationary power plants to provide standby and peaking service and to facilitate repairs of distribution lines. The Dodge Center, Minn., plant, shown here, houses two 1300 hp Alco diesels which drive two 920 kw Electric Machinery generators

More than 700 ft of this flexible G-E interlocking armored cable was pulled in within 45 minutes recently at Kaiser-Frazer's engine parts plant at Dowagiac, Michigan. The cable is easily bent over and under obstructions

The Perfection Stove Company's new −90 deg F cold laboratory is large enough to house two Greyhound buses—will be utilized in testing engines, fuels, lubricants, and heating devices at extremely low, controlled temperatures

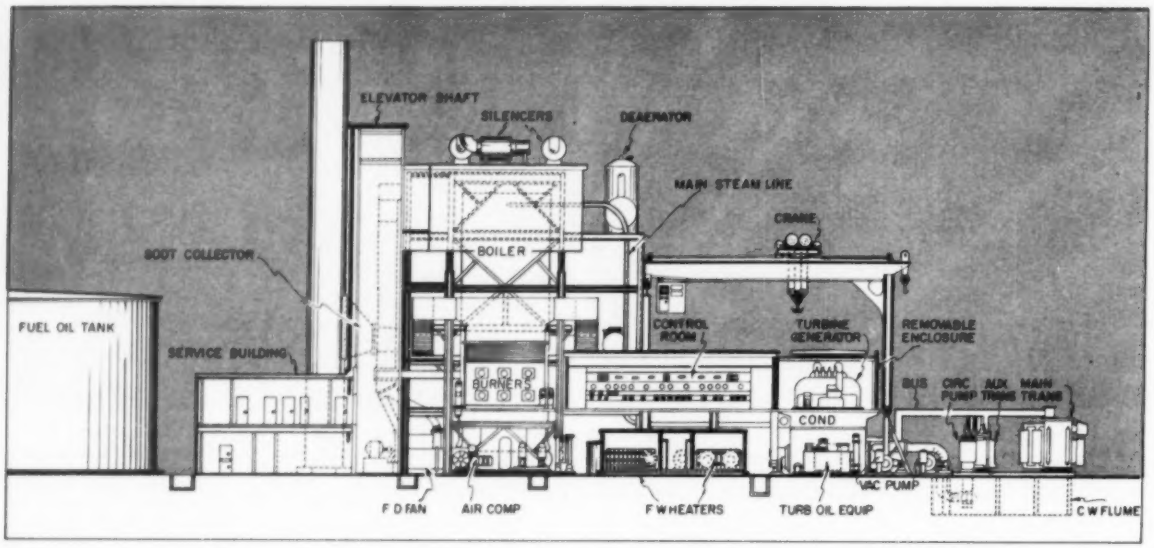


Fig. 1. Cross-section through Broadway Steam Plant, which is of a complete outdoor design and is now being built for Pasadena Light & Power Department

Broadway Steam Plant Must Take 50% Load Swing Every 20 Min

Author was responsible for layout and mechanical design of this unusual—perhaps unique—power plant in Pasadena, California. Here he tells how the unusual load swings affected design and selection of each item in the plant: main boiler and turbine units, and especially the auxiliaries, which are more affected by load swings than main units. Most important, he shows why each decision in design was made

By CHADWELL O'CONNOR

Mechanical Engineer, Municipal Light and Power Department, City of Pasadena, California

PASADENA Municipal Light and Power Department has undertaken the design and construction of one of the most unusual steam-electric generating plants to be built. Reasons it is unusual — we might even say unique — are the unusual load it has to carry and the location in which it is to be built.

The unusual load is necessitated by the California Institute of Technology's Cooperative Wind Tunnel expansion program. They currently are installing two 20,000-hp electric motors for driving wind tunnel fans. Motors and fans are so arranged that they are brought up to speed with no load and then the full load is applied over a period of 3 min. Full load then is maintained for approximately 20 min, at which time the motors are unloaded over a similar 3-min period. The net result is that we, as their sole source of power, are required to supply approximately 40,000 kw for 20 min, then turn it off for 20 min, then back on again for 20 min continuously, for from 10 to 20 cycles a day, 6 days a week, year in and year out.

On a large system, this would present no serious problem; however, on a small system such as ours, where the load rarely exceeds 50,000 kw except for evening peaks, 40,000 kw additional swing on the line presents a major problem. It nearly doubles our load for 20 min every 20 min.

If the swings were far more rapid, as is the case in the steel industry where the load swings are not felt back to the boiler, the problem would not be as great as where the swings are of sufficient duration such that the entire plant has to come to a new set of temperature conditions, equalize out, then change again. Our existing units were not designed with this type of load in mind; therefore, to handle the new wind tunnel load it was necessary to build a unit capable of carrying approximately one-half of the total swing in load, or 20,000 kw.

The first problem was: What size machine to purchase? The larger the machine, the easier it would be to carry the load. But we could not justify a very large machine because we could not load it sufficiently, with either the wind tunnel or our normal load, to take advantage of its size. Consequently we were forced into a relatively small machine, namely 40,000 kw but designed to take 50 per cent swings in load.

It was impossible to justify even the 40,000-kw unit with this one customer alone, therefore we had to use

half the machine's capability as a base load carrying part of our normal load. This meant that we had to maintain high efficiencies, necessitating relatively high temperature and pressure conditions despite the swinging load.

To further complicate the problem, space is at a premium. Pasadena's industrial area is extremely limited. The space available for this unit, plus three future 40,000-kw units, is 1¾ acres.

To cap the climax, we had to reduce the sound level of the plant to a point where the plant noise level would not exceed 85 decibels, since the plant is within a block of a residential area.

To design a steam turbine generator unit capable of successfully meeting the above conditions, and still keep maintenance to a minimum, necessitated many new designs developed through the close cooperation of the City Engineering Department and the various manufacturers involved.

Being municipally owned, we could not negotiate for what we wanted, but had to design most of the equipment in a general way in advance and write extremely exacting specifications covering many of the details that would normally be left up to the manufacturer.

Some of the more interesting features of the various pieces of equipment making up this unit are listed in the table below.

Features of Broadway Steam Plant

1. Sole supply of Caltech wind tunnel motor power, on-and-off every 20 min
2. Completely outdoor plant
3. First of four 40,000-kw machines on unit system
4. Boiler with 80-per-cent superheat range
5. Forced-draft fan suction boxes, taking hot air from boiler top
6. Boiler feed pump with booster pump, driven by one motor
7. Spray type deaerator, large storage tank, anti-flash baffling
8. Make-up water from incinerator boilers
9. Low-pressure feedwater heaters
10. Vertical pumps throughout (except b-f pumps)
11. Cooling tower for circulating water
12. Special attention to valve details
13. Centralized control panel with all related alarms and controls sectionalized
14. Automatic transfer from gas to oil fuel
15. All auxiliary motors totally-enclosed, fan-cooled, for outdoor use and noise prevention
16. Many precautions to prevent noise

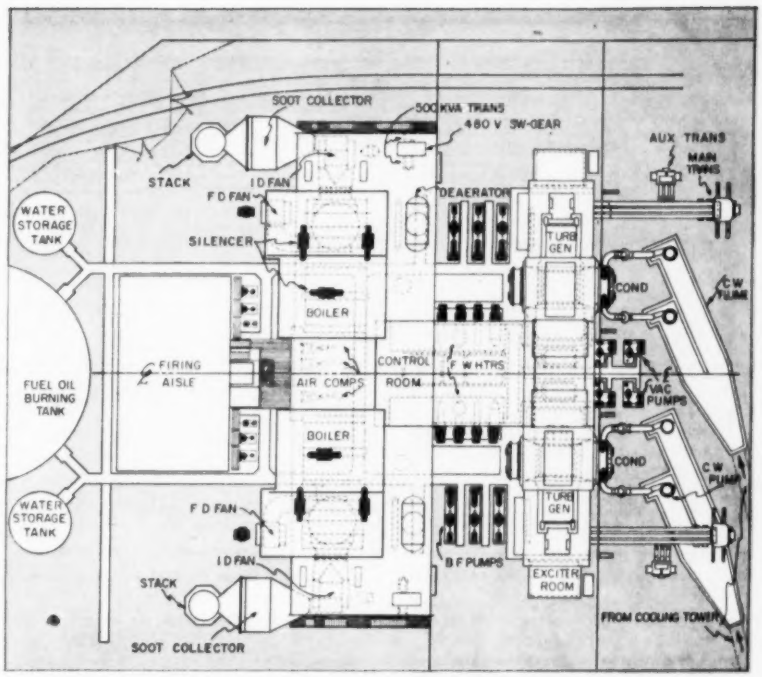


Fig. 2. Plan of Broadway Steam Plant showing first two main units with the control room between them

Over-all layout was made on the basis of four 40,000 kw units. The unit system was adopted to the point where no interconnections exist between any one of the units other than instrument air and a common operating aisle. Cooling towers are being used, since no river or sea water is available for condensing. Usually cooling-tower circulating water systems are manifolded. In our case, the circulating water piping, ducts and flumes are entirely segregated, with absolutely no interconnections, thus greatly increasing reliability and entirely eliminating all large valves.

Complete Outdoor Plant

Complete outdoor construction is being used to the point that not even dog houses or metal covers of any description are used over any piece of equipment, except for the steam end of the turbine and a modified roof over the boiler itself. Outdoor construction was picked because it gave more freedom of design to fit the equipment into the existing space. Part of the money that would have been put into the building was put into better equipment and special seals around electrical and mechanical parts.

To bring the operator closer to the control of the entire unit, including boiler, turbine and all auxiliary, a rather unusual orientation of turbine, boiler and control panel is being used. As shown in Fig. 2, centerline of turbine and centerline of boiler are parallel, with all the auxiliary equipment placed between them. Then the control room is placed at right angles to these centerlines, across the end of the boiler and turbine, overlooking the auxiliaries. In short, turbine controls, auxiliary controls, and boiler controls, both mechanical and electrical, are in a straight line on one level within easy access to the operator. An operator standing at the center of the control board has control of all equipment in front of him on one panel. From the same position he can see not only the controls, but the critical end of the turbine and the boiler, including all the burners.

Second unit will be a mirror image of the first, facing the same control area so that, when two units are in operation, the operating crew will have the controls of the second unit within 16 ft of the first unit. This is the only enclosed area.

Fuel Oil and Gas

Fuel oil is stored in underground tanks, on top of which are located the cooling towers and the cooling tower basins designed integrally with the tanks. To eliminate extra maintenance and complication of steam tracing the various fuel oil transfer lines connecting the three railroad unloading docks, one truck unloading dock with various tanks, and the plant itself, we purchased specially-built positive-displacement submerged pumps capable of pumping 100,000 SSU oil. The entire fuel oil transfer system is handled by four of these vertical submerged pumps, which pump the oil cold and force it at high pressure through the various lines.

An 11-to-1 operating range is obtained by use of constant-differential type oil burners. In order not to disturb the combustion control system

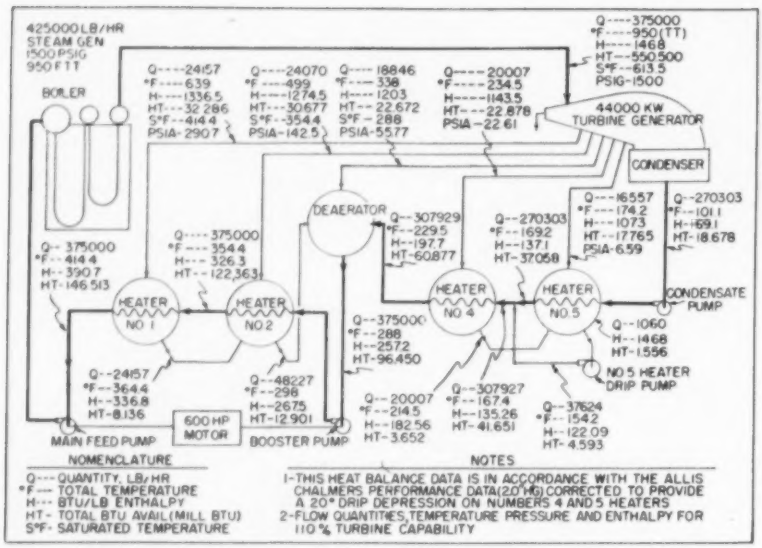


Fig. 3. Heat balance diagram first 44,000-kw unit of Broadway Steam Plant at maximum capacity

in the event of failure of the constant-differential fuel oil pump, a stand-by pump is used, which automatically cuts in upon failure of the differential pressure. At full burner capacity, the oil to the burner will be at approximately 250 F and 900 psig, and return oil from the burners, at the same temperature, and at 600 psig. The entire fuel system is 100 per cent automatic.

One Boiler per Turbine

A single 450,000 lb-per-hr boiler is being used for the 40,000-kw turbine. Most difficult boiler problem with relation to the swinging load was superheat, because the tremendous over-firing required to pick up load and the under-firing required to drop load, with a standard boiler, would force the superheat to overtravel the maximum limits set by the turbine manufacturer. With this in mind, a boiler was specified that had an extremely wide superheat range, namely 80 per cent. This means that the load can go from 20 per cent of rating to turbine capability without any change in superheat.

To obtain this wide range of superheat control and at the same time obtain fast action, a desuperheater type of control was selected. At first it was thought that the introduction of feedwater into the superheater might cause deposits in the superheater tubes; but a thorough check on plants already using this type of control showed, to our satisfaction, that the solids would not deposit out and actually would be carried through to the turbine. Some deposits on turbine blades are anticipated. With this in mind, water washing connections were made on the steam header.

As an additional aid to leveling out superheat and reducing swell and shrinkage, variable boiler pressure is being used. At capability, the boiler pressure will be 1260 psig and at minimum load it will be 1450 psig. This reduces over-firing and over-control, thus materially improving control of superheat burners, and feedwater.

Since we burn the very lowest grades of residual oil, furnace deposits and slagging form quite a problem. To alleviate it, we went to tangent tubes on the water walls of the furnace and provided more than the normal number of long retractable soot blowers. These have proved to be far more effective for removing vanadium and nickel tube deposits than the more common rotary types. If slagging should take place on the water walls, it can be water lanced through access holes placed in strategic positions.

All boiler drains connect with the atmospheric stack, which, along with each safety valve, is provided with a large silencer.

Unusual Draft Equipment

Forced and induced-draft fans are of the large, slow-speed type with inlet vane control, which, when combined with the two speed motors, provides a range of 11 to 1 air control.

The forced-draft fan is unique in that the inlets are provided with suction boxes similar to an induced-draft fan. These inlet boxes are tied together by a bifurcation, which connects with a vertical rectangular duct extending to the top of the boiler. Although the boiler is designed as a 100 per cent outdoor installation, a roof is being provided over the top of the boiler and siding extending from the roof down 20 ft. The purpose of this enclosure is not so much to protect the boiler as to provide a canopy to catch the warm air rising around the boiler and direct it into the duct leading to the forced-draft fan.

Heating the air to the forced-draft fan does not improve the over-all boiler efficiency, for the hotter the air the less efficient becomes the air preheater; however, warm dry air to the forced-draft fan does improve materially air preheater longevity. This arrangement has the added advantage of completely damping out the very objectionable noise often experienced with the usual forced-draft fan installation.

Refractory is tube suspended, including wind box and burner mounts. External surfaces of the boiler and furnace are covered with glass cloth, which stands up far better than canvas where rain, heat and sun are concerned. The glass cloth is applied with a coat of heavy mastic, reducing air leakage to a minimum. Joint between the boiler covering and the buck stays is one of the main sources of air leakage. To avoid this, the glass cloth is fastened to a sheet metal strip, which in turn bears on the buck stays, allowing for differential movement without the usual cracking experienced at these joints.

Turbine: — This is modified 40,000-kw preferred standard unit for 1250 psig and 950 F total steam temperature. The turbine is least affected by the unusual load conditions, especially since we are holding superheat within such a close range. The turbine inlet valves have been modified to accommodate the increased pressure used at lower loads. Generator and exciter are completely outdoors. The steam end of the turbine is covered with a doghouse type of enclosure, which can be removed readily for overhaul. The crane removes various sections of the doghouse.

Condenser: — Since the basic design of this plant called for an outdoor installation with no basement, elevation of the turbine operating floor level was critical. The higher this elevation, the higher the cost of the installation, since the boiler, control room, and turbine foundation all would have to be raised.

Because of relatively high quantities of ammonia in the makeup water and because of the pressure losses in the transition piece, a side-mounted condenser was not favored. Instead, a high premium was placed on the overall height of a conventional condenser mounted directly underneath the turbine exhaust trunk. A condenser with 35,000 sq ft of surface was purchased with an overall height from the bottom of the condenser to the top flange of only 11 ft 6 in.

Auxiliary Equipment

In general, the auxiliary equipment is more affected by the load changes than the major equipment.

Boiler Feed Pumps: — Considerable trouble has been experienced in our existing plant with the high-pressure feedwater heaters, due to rapid and continuous load changes. To alleviate the problem, a dual feedwater pump system was used whereby a booster pump takes water from the deaerator and forces it through

Principal Power Plant Equipment, Broadway Steam Plant, Unit No. 1

STEAM GENERATING EQUIPMENT

Steam Generator (1)—Combustion Engineering, Inc. 425,000 lbs per hour; 1250/1450 psig, 950 F., oil- and gas-fired; Peabody Engineering Corp. burners.
Steam Generator Erection—Ofcco Construction Co.
Setting—Bigelow-Liptak Corp.
Air Preheater (1)—The Air Preheater Corp. Regenerative.
Forced-Draft Fan (1)—Sturtevant Div., Westinghouse Electric Corp.
Induced-Draft Fan (1)—Sturtevant Div., Westinghouse Electric Corp.
Burner Oil Heaters (1)—Griscom-Russell Co.
Fuel-Oil Burner Pumps (2)—De Laval Turbine Pacific Co.
Constant Differential Fuel Oil Pumps (2)—Pacific Pump Co.
Fuel-Oil Transfer Pumps (4)—Sier-Bath Gear & Pump Co.
Designed for 100,000 ssu for handling oil cold
Water Columns (1)—Yarnall-Waring Co.
Feedwater Stop Check—Edward Valves, Inc.
Blow-Off Valves—Yarnall-Waring Co.
Boiler Safety Valves—Manning, Maxwell & Moore, Inc.
Chemical Feed Equipment—Proportioneers, Inc.
Feedwater Control System—Bailey Meter Co.
Combustion Control System—Bailey Meter Co.
Soot Blowers—Vulcan Soot Blower Div., Continental Foundry & Machine Co.
Fuel-Oil Tank Suction Heaters (2)—Griscom-Russell Co.
Silencers—Maxim Silencer Co.

TURBINE GENERATOR EQUIPMENT

Turbine (1)—Allis-Chalmers Mfg. Co.
40,000kw AIEE-ASME Preferred Standard unit modified for 1250/1500 psig, 950 F, 3600 rpm.
Generator (1)—Allis-Chalmers Mfg. Co.
Cooling Tower (1)—Foster Wheeler Corp.
4 cell, 8 fan, induced draft with wet bulb 72 F, final water temperature 80 F, inlet water temperature 96 F.
Condenser (1)—Foster Wheeler Corp.
2-pass, low head, arsenical copper tubes; Muntz metal tube sheets.
Condenser Tubing—Chase Brass & Copper Co.
Air Pumps (2)—Kinney Mfg. Co.
Circulating-Water Pumps (2)—Foster Wheeler Corp.
1-two-speed, 1-single-speed, vertical.
Condensate Pumps (2)—Foster Wheeler Corp.
Vertical.

FEEDWATER SYSTEM

Boiler Feed Pumps (3)—Byron Jackson Co.
Half capacity each. Booster pump and main feed pump mounted on either end of drive. Feed pump drive water-cooled.
Feedwater Heaters (4)—C. F. Braun & Co.
Deaerator (1)—Belco Industrial Equipment Div.

STRUCTURAL EQUIPMENT

Boiler Structure—Consolidated West'n. Steel, Div. of U.S. Steel Co.
Structural Steel—Pacific Iron and Steel Co.
Gantry Crane—Crane Hoist Engineering Corp.
Elevator—Elevator Maintainance Co., Ltd.
All Tanks Not Subject to Pressure—American Pipe and Steel Corp.
Circulating-Water Piping—American Pipe and Steel Corp.
Foundations—Oltmans Construction Co.

ELECTRICAL EQUIPMENT

Main Power Transformer (1)—Westinghouse Electric Corp.
Forced-oil and forced-air.
Auxiliary Power Transformer (1)—Westinghouse Electric Corp.
Fan-Cooled.
Auxiliary Switchgear—General Electric Co.
Drawout-type; outdoor.
Load Centers—Westinghouse Electric Corp.
480 v, drawout type; outdoor.
Load Centers—General Electric Co.
480v, outdoor type.
Station Auxiliary Motors—General Electric, Westinghouse and Louis Allis
All TEFC or TEWC.
Isolated Phase Bus—Delta-Star Electric Co.

OTHER MECHANICAL EQUIPMENT

Air Compressors (3)—Gardner-Denver Co.
Each 10 in x 11 in. Compressor supplies air to a single-header to which both instrument air and service air are connected.
Dessicator for Instrument Air—C. M. Kemp Co.
Duplex.
Absorptive Air Filters for Instrument Air—C. M. Kemp Co.
Duplex.
Heater Drip Pump (1)—Johnson Pump Co.
Vertical with mechanical seal.

Pumps, Miscellaneous
Bearing Cooling Water—Byron Jackson Co.
Flash Tank Pumps—Pacific Pumps, Inc.
Fuel Oil Circulating Pump—De Laval Turbine Pacific Co.
Chlorinator Circulating Pump—Byron Jackson Company
Fuel Oil Drain Tank Pumps—De Laval Turbine Pacific Co.
Power Piping Shop Fabrication—Ofcco Construction Co.

Valves, Miscellaneous
Small Instrument Valves—Dragon Engineering Co.
Large Instrument Valves—Yarnall-Waring Co.
Cocks—Nordstrom
High Temperature Cocks—Kerotest Manufacturing Co.
Valves, small, high pressure—Manning, Maxwell & Moore
Valves, large, high pressure—The Wm. Powell Co.
Reverse-Current Valves—Atwood & Morrill Co.
Check Valves—Chapman Valve Mfg. Co., Hershey, Rensselaer, Crane
Iron Valves—The Wm. Powell Co., Chapman Valve Mfg. Co.
Motor Valves—Fisher Governor Co.

Centrifuge—De Laval Turbine Pacific Co.
Bearing Cooling Water Cooler—Southwestern Engineering Co.
Gages—Manning, Maxwell & Moore
Remote Level Indicator—Yarnall-Waring Co.
Chlorinator—Wallace & Tiernan Products, Inc.
Instrumentation—Bailey Meter Co.
Expansion Joints—Flexonics Corporation
Soot Separator—Western Precipitation Co.

the high-pressure heaters and into the suction of the main feedwater pump, which in turn forces the water directly to the boiler. Thus, even though the main feedwater pressure is 1800 psig, the pressure in the feedwater heaters in only 400 psig.

To eliminate the possibility of the booster pump stopping and thus burning out the main feed pump, a single double-ended motor is used to drive both the booster pump and the main feed pump. Each pumping unit, consisting of motor, booster pump, and main feed pump, supplies half the water necessary at boiler capacity. Three pumps are used for one boiler.

BF Pump Operation

To save power and eliminate need for a fluid drive, the drooping characteristic of the pumps was specified to approximate the boiler pressure sliding scale so that as the load increased on the boiler, the boiler pressure would drop and the boiler feed pump discharge pressure also would drop a corresponding amount. This actually brought the feed pump discharge pressure below the safety valve setting at the higher loads. If, for any reason, the pressure controller were inoperative and the boiler pressure rose, it would be necessary to start the second feed pump to get the required pressure to feed the boiler. At full load, the third pump is required to get the required pressure if the boiler pressure is above normal. The boiler feed pumps are being provided with a unique breakdown bushing arrangement whereby packing of any description is eliminated and the pressure is broken down in four stages (i.e., operating pressure, booster pump pressure, condensate pump pressure and atmospheric pressure). Even the gland leakage or drip, usually associated with feed pumps, is eliminated by the use of enclosed slingers.

Deaeration in Swings

Deaerator: — The design problems in connection with the deaerator become quite involved when the load swings are very severe, particularly when load rejection is fast. This is due to the sudden drop in pressure without an immediate drop in the water temperature going to the feed pumps. This condition promotes flashing and results in serious damage to the feed pumps. There are several methods to reduce or eliminate this hazard. One is to introduce cold water in the suction side of the pump. Another is to use an excessively high NPSH. Another is anti-flash baffling, a steam dump valve on the suction of the pump, or a very large deaerator storage tank.

To keep moving parts and complication at a minimum, a large storage capacity and anti-flash baffling are specified. Storage capacity is of sufficient volume so that the deaerator pressure is maintained above the extraction pressure during load rejection for a period of approximately 20 min. This is sufficient to prevent flashing under the most severe load rejection periods.

Normally during this 20-min period, no deaeration would take place, since the deaerator pressure is higher than the corresponding extraction tap pressure on the turbine. To eliminate this problem, the author developed a simple interconnecting device so that the steam generated in the deaerator storage tank automatically is cut in to the deaerator, thus deaeration takes place uninterruptedly even though steam from the turbine has stopped.

The usual tray-type dearators so common in stationary practice are not very satisfactory for swinging loads. The least amount of hammering in the deaerator upsets the tray levels and immediately impairs proper deaeration. To eliminate this condition, the spray type, used in marine practice, was specified. To maintain good atomization during low load periods, an atomizing valve was used, which is controlled by the condenser hot well level.

All Make-up from Steam

The make-up water, instead of coming from the usual demineralizer or evaporator, comes from the incinerator boilers in the form of steam, which is introduced directly into the deaerator when the water level in the distilled-water storage tank gets below a predetermined point.

Heaters: — Because of the booster feed pump system, previously described, low-pressure feedwater heaters are used. The two highest pressure heaters are designed for only 400 psig feedwater. The swinging load and hence the swinging tempera-

(Continued on page 112)

Fig. 1. One of the two 50,000 lb per hr boilers described in this article, showing the traveling-grate stoker, CO_2 recorder, and the damper control linkage

We Remodeled Small Boiler Controls

Here's how we saved $20,000 a year on our fuel bill by remodeling our combustion controls with $4000 worth of new equipment

By R. A. STARBUCK

Maintenance Engineer, Imperial Paper and Color Corp.

THE GENERAL INCREASE in costs during the past several years has affected the small as well as the large operators, and has made it necessary to re-calculate the importance of various types of equipment in the overall economy.

When the steam plant with which the writer is associated was built in 1936, it faced far different conditions than it does now. Then, yearly coal consumption of 10,000 tons at a delivered price of $3.85 per ton amounted to about $38,500.00. Now, better than 25,000 tons are burned per year. The coal price has risen to $9.52 per ton and the total annual coal cost has reached $238,000.00. Such an extremely large increase inevitably led to investigation of all reasonable sources of economy.

The original installation had two 50,000 lb per hr Riley water tube boilers equipped with Harrington traveling-grate stokers for burning barley anthracite; induced draft and forced draft fans and other industrial steam plant auxiliary equipment. The combustion control equipment consisted of a single steam pressure actuated controller, mechanically linked to the inlet vane controls on the two forced draft fans and to the speed varying devices on the two stoker drives. Each of the two induced draft fans was regulated by a furnace draft controller.

While it might be considered possible, in theory, to vary the linkage adjustment manually at each forced draft fan and at each stoker drive, it was not practical under the conditions which existed. The steam demand was subject to almost continuous swings during the day, some of them as great as 25 per cent of the rated boiler capacity. Night loads were considerably lower and steadier. Week end loads were still lower. Severe winters made the load in winter much heavier than in summer. As a result, the steam production varied from 10,000 to 110,000 lbs per hr during the year. As might be expected, the manual adjustments to the automatic controls were made for their best operation at an average day time load and not much effort was made to correct for normal errors caused by the differing characteristics of control linkages, F.D. fan vane control, and the stoker speed control. There was also considerable overshooting, or hunting, even though the control compensation provided was used to its fullest extent.

The furnace draft regulators, in themselves, performed reasonably well, holding the draft at the point of measurement to plus or minus 0.01 in. of water. This point of measurement was in the upper part of the furnace just in front of the first row of tubes. However, the most active burning zone for barley coal is well back under a long rear arch. A considerable pressure drop occurred between this position and the point of draft measurement at heavy loads, particularly so when accumulations of slag would begin to interfere with

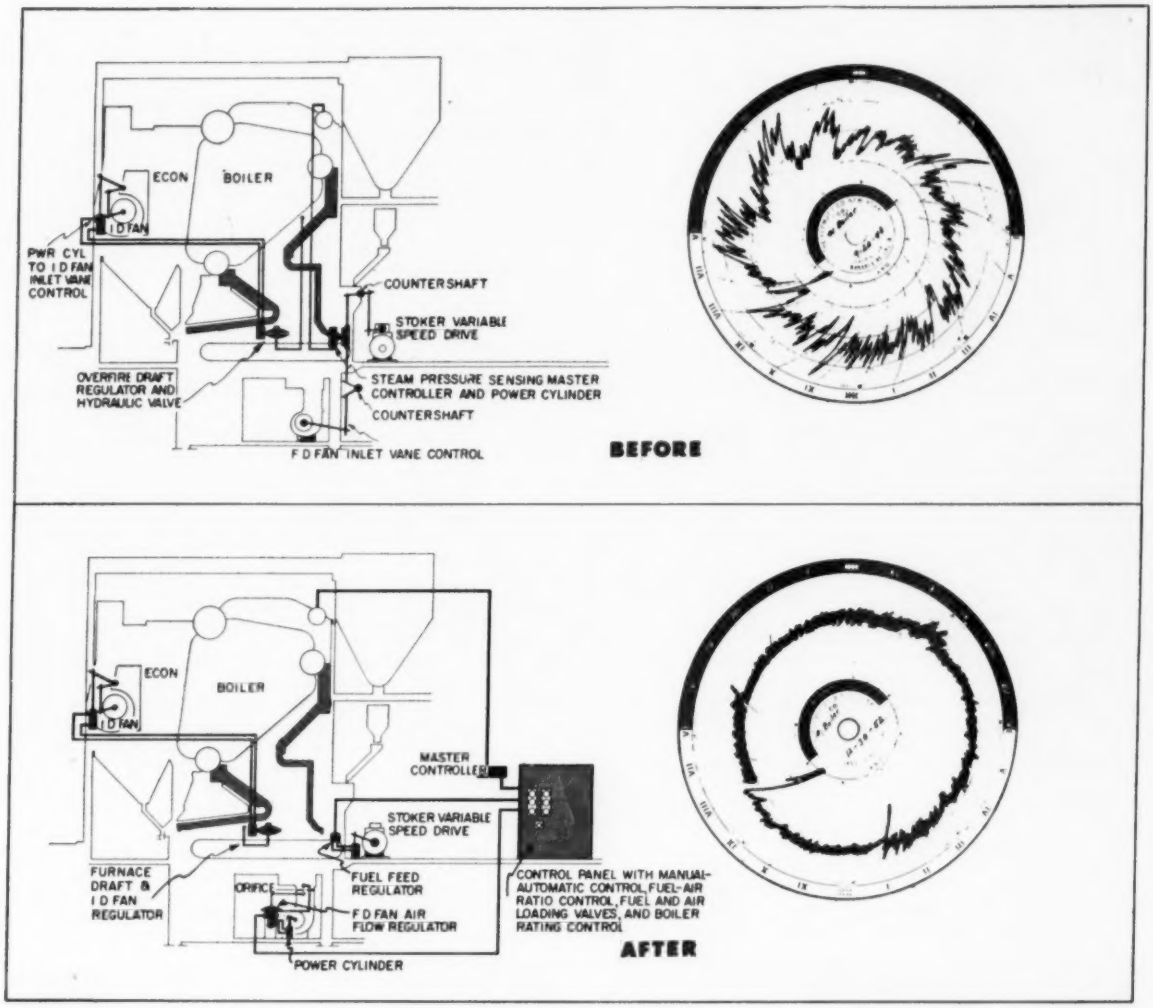


Fig. 2. Top diagram shows controls and typical CO_2 chart before changes; bottom diagram shows new control system and CO_2 chart taken after changes

gas flow. Since the draft regulators were designed to maintain a constant condition, subject to manual adjustment, the net result was that the draft at the rear of the stoker fluctuated quite widely with the load, being greatest when it was needed the least. CO_2 and boiler efficiency suffered accordingly.

The mechanically linked combustion control was installed to meet the conditions that existed in 1936, namely, moderate loads and low fuel cost. There was no clear justification for a larger investment. The results achieved were considered satisfactory at that time and at least commensurate with first cost.

However, as the demand for steam increased, it became apparent that the hunting of the control in its upper range was resulting in the inability to burn as much coal as could have been burned at a steadily controlled rate in this range.

At times the steam demand was not being met even though the stoker was handling less than its maximum amount of coal. This difficulty, coupled with the steadily increasing fuel costs, made it necessary to investigate the possibility of securing better results through the use of improved combustion control.

In late 1948, CO_2 recorders were installed on each boiler to give existing performance records which could be used to predict the savings possible with better control, and justify the cost of such control. We were also curious to see what benefit could be gained with this operating aid.

By 1950, we had enough evidence to show that the improvement secured from the CO_2 recorders alone was not very great, and steps should be taken to secure better combustion control equipment. Based on the boiler manufacturer's design and test figures, there still remained the opportunity to make about a 7 per cent improvement in efficiency. A 3 per cent saving was predicted. This was made conservative because the operating conditions were more unfavorable than those existing during a boiler performance test.

The most serious obstacle to good control was the extreme change in the full bed within the furnace under varying load conditions. The heavy air admission to the fifth zone of these six zone stokers tended to pile up the fuel on the forward part of the stoker to as much as three times its depth under the admission gate during prolonged heavy loads. At lighter loads the depth would decrease to much nearer the admission value, or gate setting. As a result, the stoker speed could hardly be depended on as a measure of the rate at which fuel was being fed to the burning zone, even with constant fuel gate setting.

Another doubtful point was the effect of the proposed improved efficiency on furnace maintenance. The close relation between furnace temperature and efficiency applied particularly to this installation, which had no water walls.

Decision was made to retain the original furnace pressure controllers, since they were doing their job well enough. After considering all factors, such as the characteristics of the boiler, stoker, fuel, associated equip-

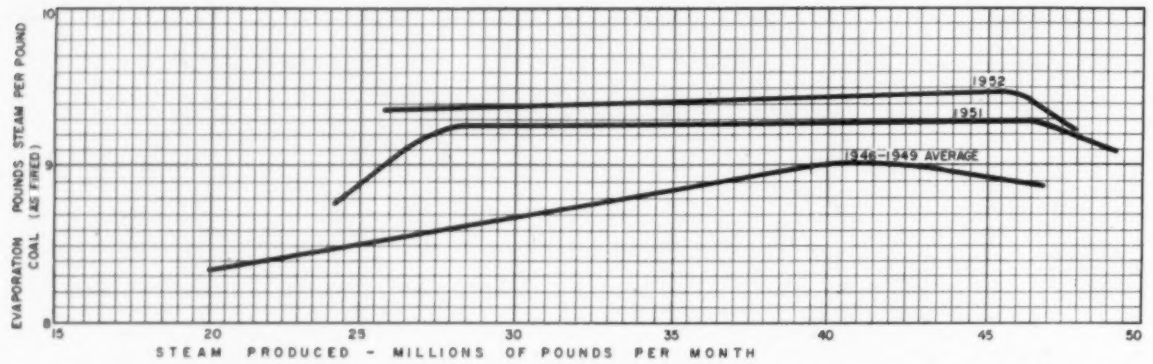


Fig. 3. Chart shows the evaporation per lb of coal in 1946–49 with original controls, and improvement in 1951 and 1952 after new controls had been installed

ment, and other control installations, it was decided to install Republic Flow Meters Co.'s pneumatic controls for the balance of the job, using a master pressure element in connection with individual regulators at each of the forced draft fans and the stokers. Fuel-air ratio regulators, manual-automatic control, and boiler rating relays were included.

The first step was to stabilize the operation of the furnace pressure controllers by determining the best point for measurement. By means of actual pressure traverses as well as trial and error, this was found to be at a point through the sidewall just at the rear of the burning zone. This point gave excellent results, but it was quite sensitive and demanded good, close operation of the controller.

The forced draft fan controllers were actuated by the master pressure element, subject to metering correction from the differential pressure across an orifice in the fan discharge duct. The power piston of the controller was connected to the inlet vane control of the fan.

Speed regulation at the stokers was secured through Link-Belt Co.'s P.I.V. drives. The regulators used to adjust the P.I.V. units are of the characteristic cam positioning type. Contours of the cams were determined by marking them at each of several stoker speeds after proper forced draft fan and burning conditions had been secured at each speed.

The results are shown in the accompanying chart of evaporation plotted against the total steam produced per month. The average for the years 1946–49 show conditions before improvement, and the improved performances in 1951 and 1952 are shown separately. The performance in 1952 was better than 1951 for these reasons: the development of a steadier steam load over the 24-hour day, possibly a better understanding of the use of boiler controls, and closer attention to several minor operational problems.

Other important benefits were obtained. Hunting of the control was eliminated, resulting in the ability to carry somewhat higher loads. Total power consumption was cut 14 per cent over the period 1948 to 1952, while at the same time the amount of steam produced increased 21 per cent. Easier and more flexible operation was secured. Furnace maintenance is no greater than to be expected with the higher steam output.

The increase in the average evaporation from 8.60 during the period of 1946–1949 to 9.40 in 1952 is equivalent to a fuel saving of about $20,000.00 per year under present conditions. By no stretch of the imagination can this be considered a poor return on a $4000.00 investment in a control installation.

Fig. 4. View of pneumatic type regulator for controlling a forced draft fan

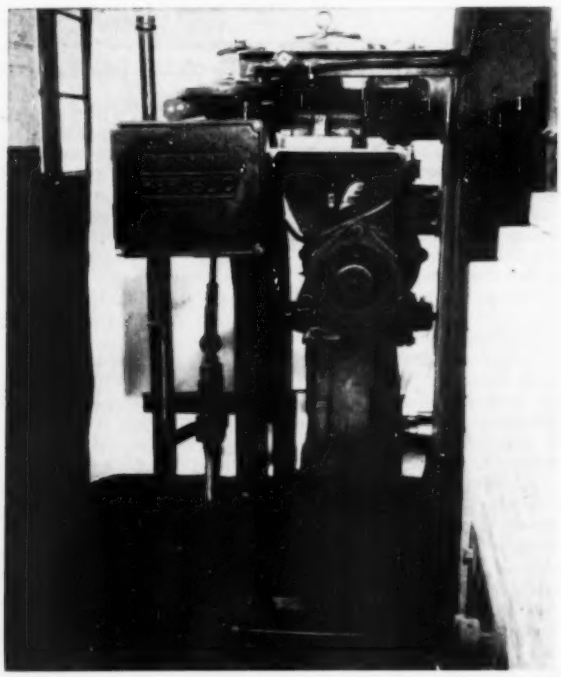


Fig. 5. Positioning regulator for adjusting the variable speed stoker drive

Power Engineering's

PRACTICAL ENGINEER and ELECTRICIAN SECTION

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What the Power Engineer Needs to Know About

Centrifugal Boiler Feed Pump Maintenance

Two preceding articles discussed the factors determining the frequency of a complete feed pump overhaul and procedures for scheduled observation and maintenance. This third article tells how the complete overhaul is carried out

By IGOR J. KARASSIK

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LET US ASSUME that the plant has the usual necessary complement of tools and instruments — such as feeler gages, inside and outside micrometers, and dial indicator gages — and that all the special tools supplied by the pump manufacturer for the dismantling operation are available. There is still one important tool, the need for which is overlooked once in a while: that is the instruction book prepared by the manufacturer. Without it (and the author has met a few isolated cases where the maintenance crew has attempted to carry out major repairs without reference to the instruction book) chances are that the overhaul procedure may be prolonged unnecessarily, to say nothing of the possibility that it may be incorrect and serious damage to the equipment may result.

In addition, some thought should be given to the parts which should be available before opening a pump for a complete overhaul. This is a good time to remind the reader that among the many advantages of carefully planned maintenance and an adequate stock of spare parts is the freedom from emergency situations and from total interruption of service. Emergency repairs resulting from a lack of necessary parts may require the hiring of extra repair crews for work which cannot be carried out in sufficient time with the existing personnel. In many cases they may force the maintenance foreman to perform temporary and makeshift repairs which could double the cost of maintenance expenditures.

The number of boiler feed pumps installed and the extent to which repairs of worn parts can be carried out in the field will determine to a great extent the minimum number of spare parts which should be carried in stock at the site of the installation. The minimum for any installation should include the following:

1. A set of casing wearing rings.
2. A set of impeller rings (if used).
3. A set of interstage or diffuser bushings.
4. A spare balancing device made up of rotating and stationary parts (if used).
5. A set of shaft sleeves (preferably two sets).
6 Several sets of packing.
7. A set of bearings (if ball bearings) or bearing bushings (if sleeve bearings).
8. A spare thrust collar and a set of thrust shoes if a Kingsbury type thrust bearing is used.

It further is recommended that a complete spare rotating element be carried for the boiler feed pump installation. This spare rotor can be installed in the pump if examination or tests show that the pump rotor has become worn excessively or if it is damaged accidentally. In that event, the rotor withdrawn for overhauling can be rebuilt immediately in the field with parts from the preceding list.

In order to obtain the greatest service from spare parts, certain of these parts should be carried in stock with undersize bores or oversize turns. The methods used in obtaining such increased service from parts will be discussed in a later article of this series.

Complete Overhauls

Great care should be exercised in the dismantling operation. After closing the suction and discharge valves, as well as any other valves which will isolate the pump from the system (such as in the balancing device leak-off line, if the pump is so constructed), the pump casing should be drained. Any small piping which may interfere with the disassembly of the pump should be removed. Disconnect the coupling and remove such external parts as bearing covers in accordance with the manufacturer's instructions

If the pump casing is split axially, remove the dowel pins and the casing bolt nuts and lift the upper half of the casing straight up (as in Fig. 1) to prevent damage to the internal parts. Remove the rotor in a similar

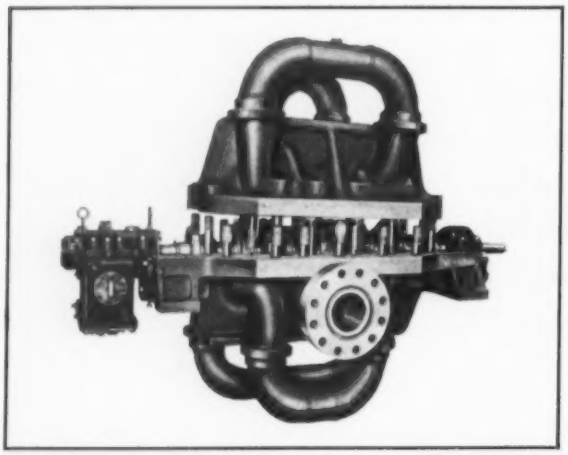


Fig. 1. Lifting the upper half of the casing of an axially-split volute type casing exposes both the impellers and wearing rings for visual inspection

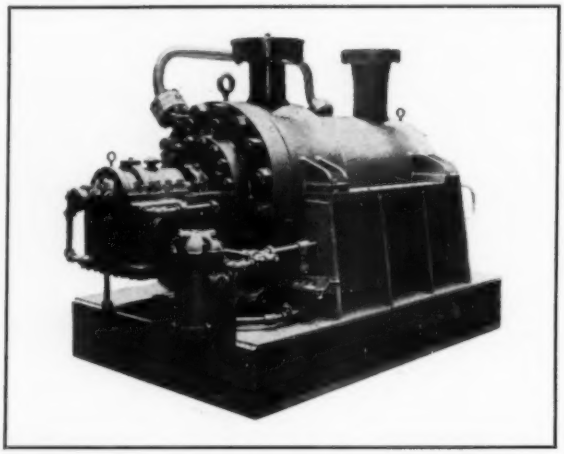


Fig. 2. Radially-split casings require that the inboard and outboard bearings, balancing device and discharge head be removed to check the interior

manner, vertically and with extreme care, to prevent injury to the impellers, wearing rings, and other parts.

Radially-split casing pumps of the type illustrated in Fig. 2 require a somewhat more complex procedure. The inboard and outboard bearing assemblies, the balancing device and the discharge head are removed before the inner element (rotor and inner casing) is withdrawn from the outer casing. A special assembly carriage as shown in Figure 3 may be used for this operation. If the inner element is bolted to the casing barrel, the bolting is freed. A dummy cross is bolted to the inboard end of the casing and sleeves are mounted on the exposed end of the shaft to protect it against scoring when it is pulled through the dummy cross.

Withdrawing Rotor

The carriage is adjusted to the proper elevation and secured to the casing, the shaft is secured to the cross-bar of the carriage and the rotor is withdrawn from the casing onto the carriage by using a rack and pinion gear. It can be dismantled further at leisure in whatever location such work can be carried out most conveniently.

It is most important that, as the pump and rotor are dismantled, *the various parts be marked adequately as they are removed* to assure proper reassembly. Each individual part and all important metal-to-metal or clearance joints should be examined carefully, *and a record kept of all clearances.* In many cases, photographs of the appearance of the various parts should be taken. If the pump is generally in satisfactory condition, a comparison of these photographs with the appearance of the pump at the next overhaul will prove very beneficial. If any damage has taken place, photographs are a valuable aid in describing the nature and extent of this damage to the pump manufacturer when requesting suggestions on the overhaul.

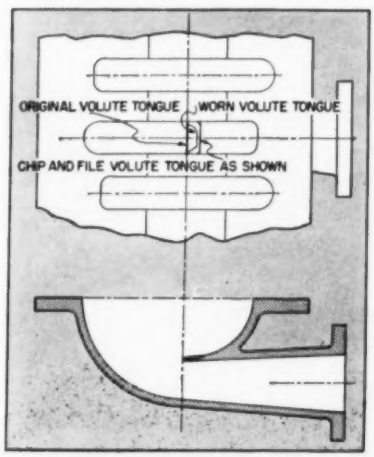


Fig. 4. Worn volute tongues (or cut-waters) may be repaired by trimming and shaping as shown here

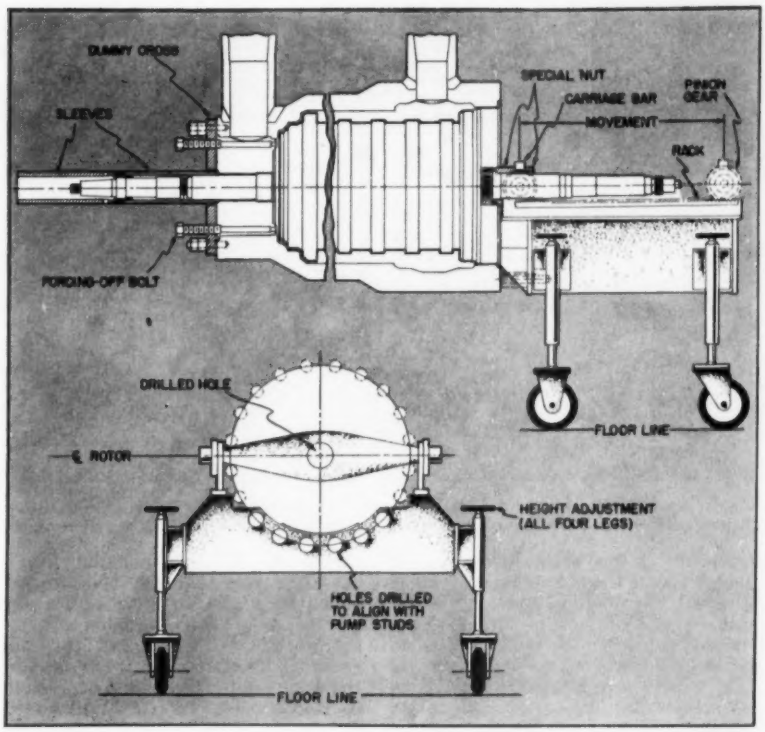


Fig. 3. Rotor of radially-split-casing pump is best removed by a special assembly carriage. The carriage is designed for a specific pump, but is adjustable to accommodate irregularities in floor surfaces

While the first article of this series recommended that the pump be opened up only when performance tests or other evidence of excessive wear indicate the need of a complete overhaul, it may be that the pump has been opened up after operating satisfactorily with only a slight reduction in capacity due to increased leakage. A decision on reconditioning while the pump is open will depend on several factors:

1. Availability of spare parts.
2. Length of time the pump can be left out of service without jeopardizing operation of the steam power station.
3. Economic considerations and importance of getting the longest service from the pump without overhauls.

As a general rule, regardless of the performance of the unit, parts appreciably worn should be renewed if it is not intended to examine the pump again for a very extended period of time. It also should be remembered that when parts with metal seats in new or good condition are assembled in contact with dirty or worn parts, the new parts are very likely to wear out rapidly.

Casing Maintenance

The casing or diffuser waterways should be cleaned and repainted thoroughly during a complete overhaul. Special care should be exercised to examine the waterways for corrosion which, on cast iron, frequently manifests itself by graphitization. If severe corrosion takes place, the manufacturer should be consulted on the possibility of substituting materials, either for the rotating element or for the casing itself, which would be more impervious to the characteristics of the feedwater.

A word of caution should be introduced at this point with respect to the cleaning of cast iron or carbon steel casings. In a few cases, the author has encountered casing which showed no corrosion after a number of years of service. Prior to reassembly the casings were wire-brushed thoroughly, and in a few months the pumps were subject to extremely severe corrosion-erosion in the waterways. The explanation seems to be that a protective oxide film had formed in the early period of operation, at a time when feedwater conditions apparently were not unfavorable. Even after the conditions changed, no attack of the metal took place because of the protection afforded by the oxide film, but as this film was wire-brushed away, all protection disappeared and the casings were damaged seriously. Such evidence is somewhat intangible, but is given here in the hope that caution will be exercised in the analysis of feedwater conditions and condition changes.

If the casing is pitted or eroded in places, it often is possible to restore it by welding, brazing, silver soldering, or metal spraying, depending upon the facilities available. Special care should be taken to examine and recondition the metal-to-metal fits where stationary parts,

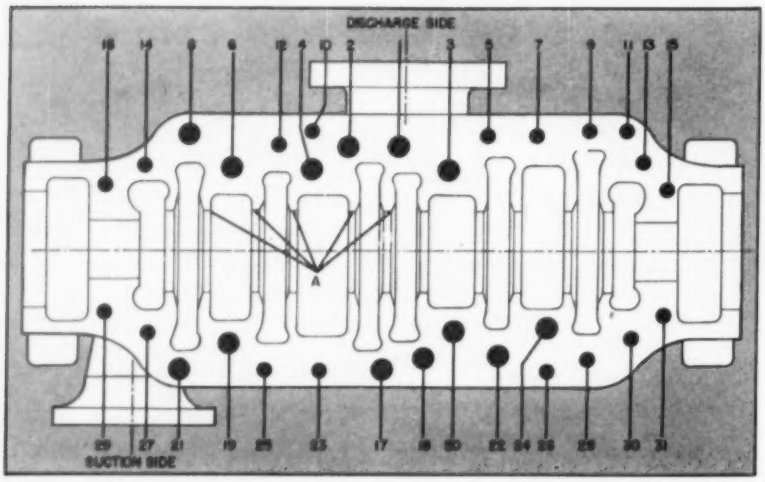


Fig. 5. Casing bolts should be tightened in a specific sequence determined for each pump. The above is a typical sequence for axially-split-casing pumps. "A" shows edges requiring 0.015-in. gasket overlap

such as casing rings, diffusers, or stage pieces seat in the casing. If the latter is made of steel, and these fits show signs of erosion, it might be advantageous to face them with 18–8 stainless steel and refinish. Attention also should be paid to the cut-water, or tongue, in volute casings. When it is worn unevenly it should be cut back, filed, and faired as shown in Fig. 4. The same is possible to some degree in the vane tips of diffusers although generally they cannot be built up by welding. Care should be taken not to distort or warp the casing during the overhaul and, after repairs are completed, the horizontal flanges of an axially-split casing should be refinished to the proper surface.

Except for some very special designs, every axially-split-casing pump has a gasket which may be damaged when the pump is opened, and a new gasket should be available for replacement if needed. If the old gasket adheres to the lower half of the casing and it is in good condition, it is not necessary to replace it, but it should be replaced if damaged in any way. The new gasket should be of the same thickness as the original one and of the same type of material so that it will compress to the same extent. A gasket which is too thick generally will lead to casing cutting through leakage; if the gasket is thinner than the original one, tightening the two casing halves may exert undue force on the casing wearing rings and distort them. This may lead to contact with the rotating parts and severe damage may result.

The procedure followed when installing a new horizontal joint gasket is illustrated in Fig. 5, which also illustrates the tightening procedure of casing bolts. The gasket first is cut for the outside contour and the bolt holes, using any approved method. However, the gasket *must not* be hammered at the dowel holes, as they would be ruined for fit and alignment. The inner edge of the gasket then should be marked and cut with scissors, leaving all edges 1/16-in. full. Never hammer the gasket at the edges of the bores as this wrecks the bores for all time.

Final Trimming

The final trimming operation is best accomplished by first cementing the gasket to the lower half of the casing with shellac and then placing the top half of the casing over the gasket to keep it flat while the shellac dries. Of course, all foreign matter must be removed from the casing flanges before applying the gasket to the lower casing half.

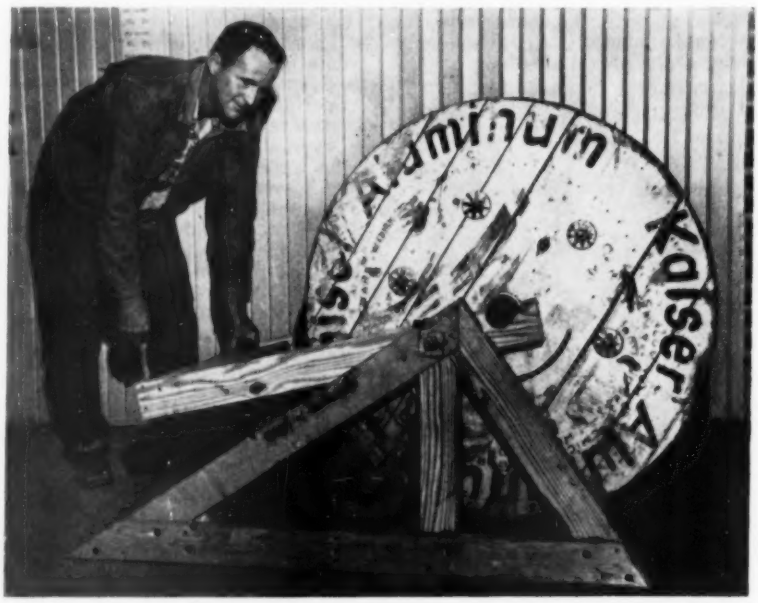
At certain strategic points where the gasket will contact stationary parts, such as casing rings and stage pieces (marked "A" on Fig. 5), the final cutting should result in about 0.015-in. overlap so that tightening of the two casing halves will press the edges of the gasket against the stationary parts, assuring proper sealing. At all other points inside the casing, the gasket is trimmed even with the edges by following the outline with a sharp cutting tool.

Before replacing the top casing half, powdered graphite should be rubbed into the gasket to prevent it from sticking to the top when it again is removed.

Brain Saves Back and Fingers

WHEN BILL NORRED, electric serviceman, crushed a finger manhandling a cable reel off its stand, he decided there must be a better way to do the job. The illustration below shows Bill with the reel stand he designed and built. The lever enables the reel to be raised and lowered easily and safely. Though some engineers consider it unsuitable for very heavy reels, or field work where it might be roughly handled or have to work off uneven ground, for small and medium reels, and where it can be set on a level surface, it does an excellent job.

Though the reel stand shown is made of wood and has the limitations mentioned above, the idea could be expanded by using steel or iron pipe for the frame. The supports could easily be made adjustable for rough ground.



Three Fast New Ways to Cut and Drill Concrete, Granite, Refractories

FOR FURTHER INFORMATION about any of these methods write the Editor, or use one of the postage-paid cards elsewhere in this issue

This one melts its way through

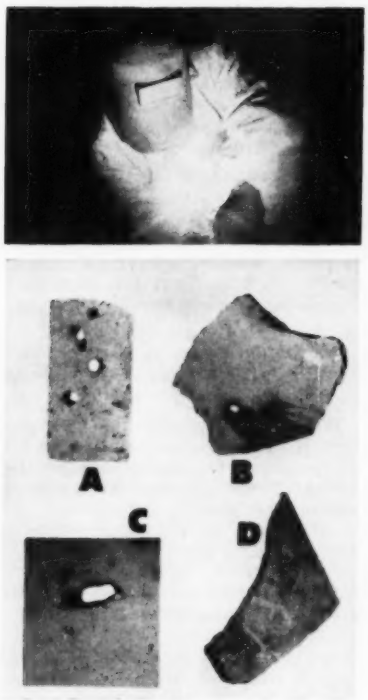


Fig. 1. Holes like those above are produced by an electric arc. Materials cut or pierced are A. Firebrick, B. Granite, C. Transite, and D. Concrete

THIS NEW METHOD uses a special electrode, which, when operated from a standard welding machine, produces a combination of flame and arc with a temperature of 8000F that melts its way through practically any known refractory material. The electrode, known as a Dynatrode, looks like an ordinary welding electrode, but has the important difference that it can sustain an arc by itself in mid-air, and does not rely on the work to provide a return path for the current.

The only equipment required to use this new process is the Dynatrode, and a special holder for it, with any standard welding machine of 400 amp or more capacity. The Dynatrode is handled just like an ordinary electrode, and the special holder will take ordinary arc welding electrodes.

The Dynarc process, as this new method is called, can be used to cut holes in reinforced concrete, pierce holes in floors for machine foundation bolts, remove slag from furnace floors, drill holes for blasting, cut holes for steam pipes and electrical conduit, demolish stacks and other structures, cut wire fencing, cut sewer pipe, firebrick, tile, and other refractories. No special training is necessary.

This one bores its way through

Fig. 2. Precision holes are bored by the bit shown above. Teeth are carbide tipped. Removable starter (lower left) is handy for locating large holes

THE METHOD DESCRIBED on the left makes a rough hole, since it actually melts the material away from the front of the electrode. Where a smooth parallel hole, or a fairly deep one, is required, the rotary carbide tipped tool shown below does an excellent job. The spiral grooves carry away the dust as it is pulverized, so the bit does not jam, however deep the hole, and unlike more conventional drills, the drilling speed is constant, whatever the depth of hole. In hard concrete with aggregate, this bit will cut an average of 6 in. per minute. It operates with an ordinary rotary notion, pressure being maintained all the time by the operator. For drilling in switchrooms or other buildings housing delicate equipment that must not be jarred, it has the advantage, unlike impact type drills, of smooth, quiet operation. The carbide cutting tips can be replaced when they wear out.

With the bit shown comes a removable center for precision locating and starting of holes; this allows large diameter holes to be started without undue pressure on the bit, and without the drill "walking" around before it can be located in the right spot.

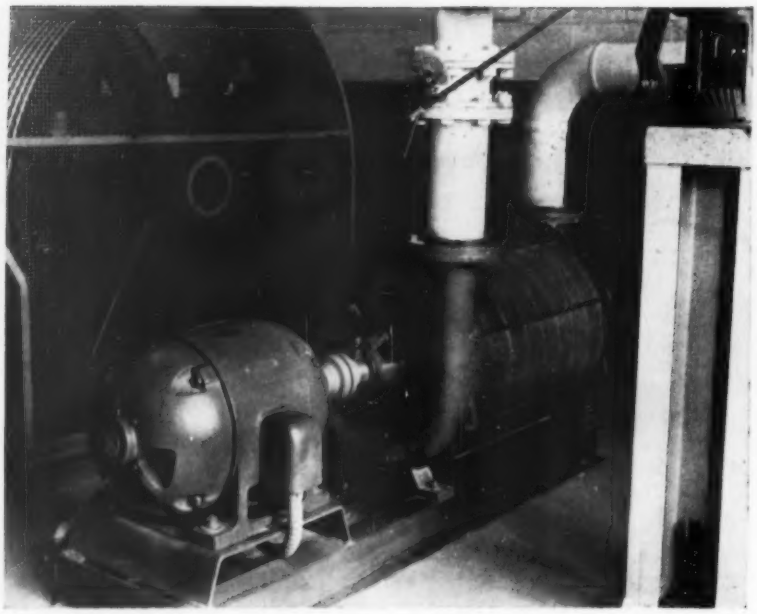
This one bashes its way through

Fig. 3. Heavier duty is performed by this impact drill. At 3000 strokes per minute the 4½ in. bit will drill granite at the rate of 45 ft per hour

THE NEW TYPE of drill bit shown above drills a 4½ in. hole in granite at a rate of 45 ft per hr; this is three times as fast as granite has ever been drilled before, and many times faster than the normal drilling rate. The drill, which is about 5 ft long and less than 4 ins. diam, has a solid head bit, and works like a small high speed pile-driver. It has 2 pistons, and is operated by steam. The steam gives a series of impacts up to 3000 four-in. strokes per minute. Exhaust steam from the hammer piston is ejected through one center hole at the drilling tip and effectively carries away dust and chippings that otherwise would clog the bit.

The drill is designed to beat on solid head bits because the impact is so severe it breaks the teeth on ordinary bits. The bit head has 4 tungsten carbide inserts, and heads are made in sizes from 4½ in. to 12 in.

Steam for working the drill comes from a portable steam generator. Recent tests show that it takes about 2400 lbs of steam per hr at a sustained pressure of 400 psi to operate the 4½ in. drill. The photograph above shows Ross Bassinger, the inventor, holding one of his new drills.



Typical blower installation providing the cooling air to electronics apparatus for Eastern fabricator

Following These Simple Rules . . .

Figuring Centrifugal Blowers Is Easy

ENGINEERING APPLICATIONS of centrifugal blowers often require finding the pressure and volume of the gas delivered and the horsepower required by the motor after blower speed, inlet gas temperature and inlet gas density have been changed. Although the laws relating these variables are simple, it is often hard to find the useful formulas because they do not appear in the same reference sources. To simplify the solution of mathematical problems arising with the application of centrifugal blowers, the fundamental engineering laws have been compiled for easy reference by O. W. Acheson of Lamson Corp.'s Billmyre Blower Division.

In the following formulas these symbols are used:

P = Pressure in psi or inches Hg
V = Volume in cfm
N = Speed in rpm
D = Density in lb per cu ft
H = Height of air or gas column in ft
SG = Specific Gravity
"Standard Air" = Air at 68 F (absolute temperature 528 deg) and 29.92 in. Hg (barometric pressure at sea level)

Variation of Blower Speed

Changing the speed of a centrifugal blower influences volume, pressure and horsepower input according to three laws:

The volume changes in direct ratio to the speed.

Example:

Given a blower operating at 1750 rpm and delivering 1000 cfm. If the speed is increased to 3500 rpm, what is the new volume?

Let V_1 = original volume (1000 cfm)
V_2 = new volume
N_1 = original speed (1750 rpm)
N_2 = new speed (3500 rpm)

$$V_2 = V_1 \times \frac{N_2}{N_1} = 1000 \times \frac{3500}{1750} = 2000 \text{ cfm}$$

The pressure changes as the square of the speed ratio.

Example:

Given a blower operating at 1750 rpm and delivering air at 1 psi pressure. If the speed is increased to 3500 rpm, what is the new outlet pressure?

Let P_1 = the original pressure (1 psi)
P_2 = new pressure

$$P_2 = P_1 \times \left(\frac{N_2}{N_1}\right)^2 =$$

$$1 \times \left(\frac{3500}{1750}\right)^2 = 1 \times 4 = 4 \text{ psi}$$

The horsepower changes as the cube of the speed ratio.

Example:

Given a blower operating at 1750 rpm and requiring a 5-hp motor. If the speed is increased to 3500 rpm, what is the new horsepower required?

Let hp_1 = original horsepower (5 hp)
hp_2 = new horsepower

$$hp_2 = hp_1 \times \left(\frac{N_2}{N_1}\right)^3 =$$

$$5 \times \left(\frac{3500}{1750}\right)^3 = 5 \times 8 = 40 \text{ hp}$$

Inlet to Outlet

The outlet pressure of a blower depends on the condition of the air or gas at the inlet. The inlet condition is influenced by specific gravity, altitude (location of blower), and temperature of inlet air.

Pressure varies in direct proportion to the density.

Example:

A 3-psi (standard air) blower is to be used to handle gas having a specific gravity of 0.5. What pressure does the blower create in handling the gas?

Let P_a = air pressure (3 psi)
P_g = gas pressure
SG = specific gravity of gas (0.5)
$P_g = P_a \times SG = 3 \times 0.5 = 1.5$ psi

If we are required to handle a gas having a specific gravity of 0.5 at 1.5 psi pressure, we can determine the rating of the standard air pressure blower as follows:

$$P_a = \frac{P_g}{SG} = \frac{1.5}{0.5} = 3 \text{ psi}$$

Outlet pressure varies in direct proportion to barometric pressure.

Examples:

A blower is to operate at an elevation of 6000 ft (barometric pressure from table = 23.79 in. Hg) and is to deliver 3 psi pressure. What pressure (standard air) blower is required?

$$\text{Pressure} = 3 \times \frac{29.92}{23.79} = 3.77$$

(or about 3¾) psi

If it is desired to determine the pressure a 3-psi (standard air) blower will deliver at 6000 ft altitude, proceed as follows:

$$\text{Pressure} = 3 \times \frac{23.79}{29.92} = 2.38$$

(or about 2⅓) psi

Table showing air pressure for various altitudes

Altitude (ft)	Barometric Pressure (in. Hg)
0 (Sea Level)	29.92
1000	28.80
1500	28.26
2000	27.72
2500	27.20
3000	26.68
3400	26.28
3800	25.88
4200	25.49
4800	24.91
5200	24.53
5600	24.16
6000	23.79
6600	23.26
7200	22.73
7800	22.21
8400	21.70
8800	21.37

Outlet pressure varies in inverse proportion to the inlet temperature.

The air density varies in inverse proportion to the absolute temperature (absolute temperature is obtained by adding 460 to the Fahrenheit reading).

Examples:

A blower is to handle 200 F air at 3 psi pressure. What pressure (standard air) blower is required?

Let P_1 = pressure of hot air (3 psi)
P_2 = standard air pressure rating
AT_1 = absolute temperature of hot air (660)
AT_2 = absolute temperature of standard air (528)

$$P_2 = P_1 \times \frac{AT_1}{AT_2} = 3 \times \frac{660}{528} = 3.75$$

(or 3¾) psi

A blower is capable of delivering 3 psi pressure with standard air. What pressure will it develop handling 200 F inlet air?

$$P_1 = P_2 \times \frac{AT_2}{AT_1} = 3 \times \frac{528}{660} = 2.4$$

(or about 2⅖) psi

Other Relationships

The remaining relationships of interest to the practicing engineer are:

The horsepower varies in direct proportion to the specific gravity of gas at the inlet, and volume varies in inverse proportion to barometric pressure.

Examples:

A standard-air blower requires a 10-hp motor. What horsepower is required when this blower is to handle a gas whose specific gravity is 0.5?

$$hp = 10 \times 0.5 = 5 \text{ hp}$$

A blower is to operate at 6000 ft altitude (barometric pressure from table = 23.79 in. Hg) and is to handle 1000 cfm of standard air. What is the cfm of air the blower must handle at 6000 ft?

Let V_1 = volume of standard air (1000 cfm)
V_2 = volume of thinner air
H_{s1} = barometric pressure at sea level (29.92)
H_{s2} = barometric pressure at 6000 ft (23.79)

$$V_2 = V_1 \times \frac{H_{s1}}{H_{s2}} = 1000 \times \frac{29.92}{23.79}$$

$V_2 = 1255$ cfm

How to Sharpen Carbide Tipped Masonry Drills

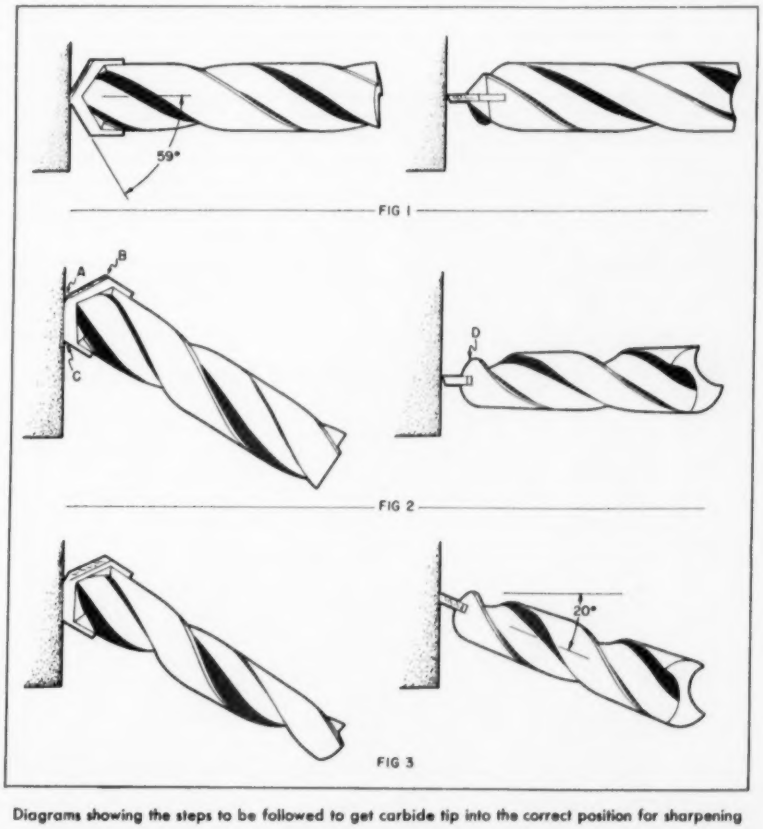
SOME TIPS on sharpening carbide tipped masonry drills have been outlined by the Carboloy Department of General Electric Co. They recommend using a silicon carbide wheel (C100-18V or C80-18V) for resharpening the drills and restoring the original 118 deg included angle of the carbide tip. The drills should be sharpened when a 1/64 in. or more flat develops on the cutting edge. The diagram shows the steps to be followed to get the tip into the right position against the grinding wheel.

First bring the bit up to the vertical face of the wheel, holding the drill horizontally, with the shank of the drill at right angles to the surface of the wheel as shown in Fig. 1. Then, still keeping the drill shank horizontal, move it round until the shank makes an angle of 59 deg with the wheel surface, as shown in Fig. 2. This position makes sure the 118 deg included angle of the carbide tip is maintained.

Still keeping this 59 deg angle with the wheel surface, depress the drill shank until it makes an angle of 20 deg with the horizontal. This is the correct position for sharpening, in which the drill shank makes an angle of 20 deg with the horizontal and 59 deg with the wheel surface. Maintaining these angles, and using moderate pressure, move the drill back and forth across the wheel. Do not let the bit overheat, and do not drop it into liquids to cool.

When one edge has been sharpened, turn the bit over and do the same for the other cutting edge. Always make sure the two cutting edges, AB and AC in Fig. 2, are the same length; if one is longer than the other the drill will make oversize holes.

Repeated resharpening of the drill will reduce the clearance between the carbide tip and the steel shank. When necessary, grind away the steel behind the tip so that the steel is nowhere closer than 1/32 in. to the working surface of the carbide blank. The part to be ground away is shown at D in Fig 2.



Diagrams showing the steps to be followed to get carbide tip into the correct position for sharpening

Atomic Power Reprints

We have so many requests for "Sources of Information on Atomic Power", July issue, that we have made reprints of it. To obtain a free copy, merely write "Source" on the prepaid post card, page 35 or 137 of this issue and mail it to us. Your copy will be mailed at once. We also have a number of copies of the Atomic Power Section published in the June issue. To get one of these, just write "Atomics" on the post card.

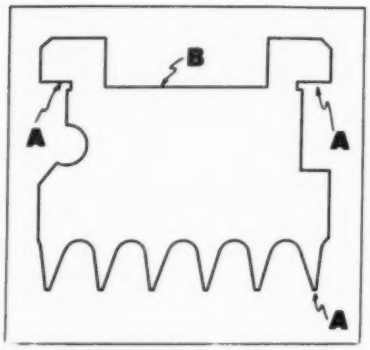
PRACTICAL HINTS AND KINKS

How about the gadget you made or the trick you used to do your job better? Write us about it. Send a sketch too. You will be paid well for contributions.

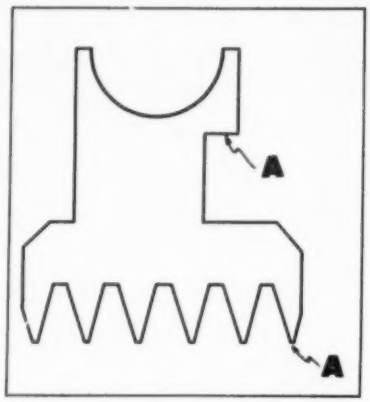
Salvage Steam Turbine Labyrinth Packing Rings

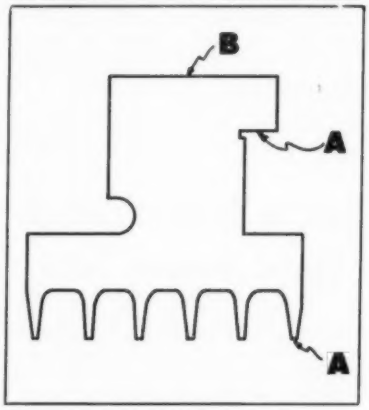
HAROLD F. SLAGLE of Long Beach Naval Shipyard suggests that worn packing rings of the labyrinth type be salvaged by removing a minimum amount of material from the butt joints and remachining the locating surfaces. The sealing fins also must be remachined to design size. The salvage suggestion was reported recently in the *Bureau of Ships Journal*.

The Bureau believes that in many cases the suggestion can be used and will result in time and material savings. To rework the rings, all surfaces marked A in the illustrations must be bored to design diameter. The part of the surface marked B, in the path of the flat or compression coil springs, first must be built up with brazing alloy and then machined to design diameter. This will retain the required spring loading. Spring loading is not critical on packings using garter springs, and brazing in the path of the spring to retain tension is not required.



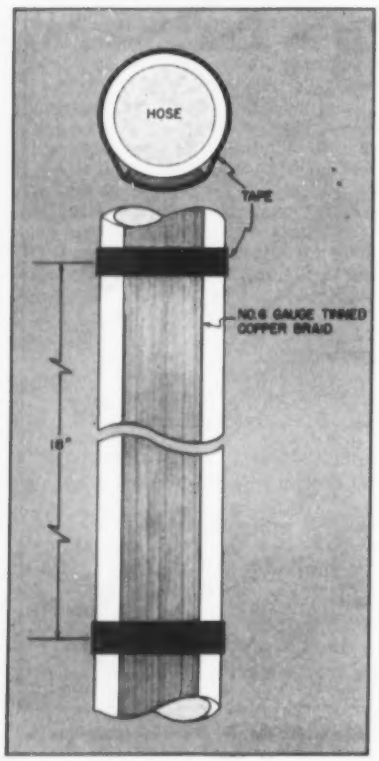
Cross-sections of typical labyrinth packing rings





A Neat Way to Ground Air Power Tools

By PAUL C. ZIEMKE



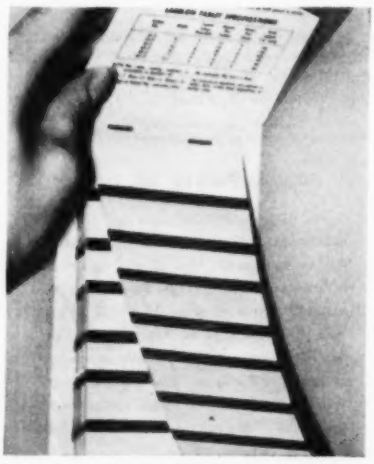
DRILLING HOLES in streets, building floors, roofs, or unknown ground is always a dangerous job, owing to the possibility of piercing buried electric cables or conduits. The operator can be protected by connecting the power tool to a water main or driven ground rods by a stranded copper conductor. The objection to this method is that it clutters up a job with extra trailing wires, and the connections have to be remade for every operating position.

We have found that a good way to safeguard the operator and at the same time avoid extra trailing wires is to solidly fasten a tinned and braided flat copper conductor along the length of each piece of hose with plastic tape or smooth turns of light binding wire. At couplings between hose lengths we join the braid with heavy duty galvanized battery charging clips, which are brazed to the braid. By using these clips, the hose sections are easily joined, no matter which end of the hose is attached to the tool or no matter which end of the hose is joined to the air supply, and there is no limit to the number of lengths that can be connected together. Try it for safety's sake.

Labeling Tape for Typed Data

READERS who make it a practice to label all circuit wiring and similar installations will welcome a new form of labeling tape which was announced recently. It is designed for typewriter use and comes in tablets of flat labels backed up by non-adhering sheets.

The new form possesses all the advantages of the tape as reported in POWER ENGINEERING, November, 1952 — that is, it will stick without moistening to any smooth, clean surface, and it can be written on with any dry, blunt point (such as a pencil or stylus) as well as with a typewriter. Writing appears beneath a thin, tough film of transparent plastic on a white, waxy writing surface. Pressure of the writing instrument alone causes the writing to appear.



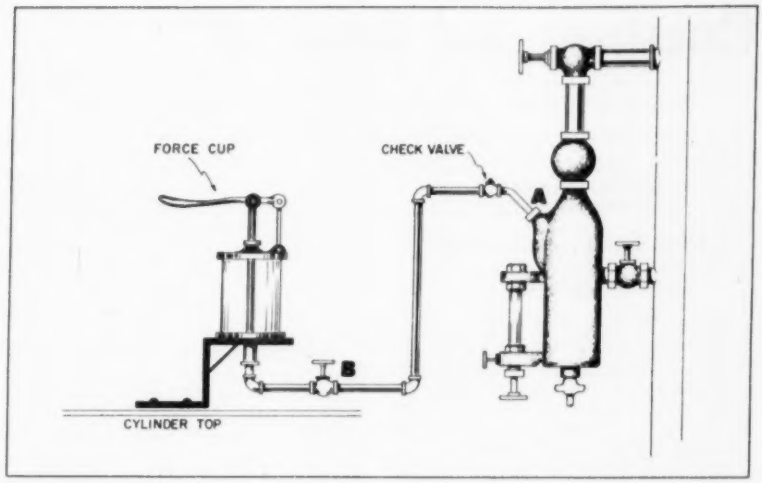
Labeling tape for typewriter use comes in sheets

Lubricator Refilling Made Easy

By ALBERT H. MOULTON

ONE OF THE drawbacks of the hydrostatic lubricator was the frequent refilling which necessitated shutting off, draining out the water and pouring in the oil, which, if not at the right temperature, was a slow and sometimes a messy procedure. Often it was so placed as to be hard to reach without a step ladder, especially on engines where it usually was set several feet above throttle for good cylinder lubrication.

One day I dropped in to see an engineer friend of mine in a nearby plant, and after we had chatted awhile he said casually, "Well, guess I had better fill my engine lubricator." Imagine my surprise when, instead of going through the usual routine of shutting off, draining out water and pouring in the oil, he simply poured cylinder oil into a force cup mounted on cylinder, opened a small valve and started pumping; that was all there was to it. When I asked him where he had gotten the idea, he said he had figured it out for himself. The following sketch shows the hook-up of a double connection lubricator. At A the handled filler plug was sawn off, drilled and tapped for a ⅛ in. pipe nipple which was soldered in to make an oil tight joint. A check valve was installed to prevent oil backing out of lubricator. A valve at B gives positive shut off.



The operation is simple: fill the force cup, open valve B and start pumping; the oil pressure forces water out of lubricator into steam pipe (sight glass shows when it is full), shut off valve B and job is done and oil feed is not disturbed.

All piping and fittings were brass and all joints were soldered for tightness, as oil has a way of working out around threads.

Eight Tips for Sealing Storage Battery Cells

By HARRY W. SMITH

USERS of storage batteries sometimes find it is necessary to remove the cover from a cell for internal inspection and repairs. In reassembling the cell unit, it is essential that a proper seal be obtained between the cover and the jar. Gould-National Batteries, Inc. offers these eight tips to good results:

1. Use the right compound. Ask your battery manufacturer what compound to use. In most cases battery makers will supply sealing compound packaged, ready for use.

2. To melt the compound, almost any convenient source of heat may be used such as a gas burner, electric hot plate or blow torch. Do not raise the temperature of the compound higher than necessary to permit easy pouring of the melted compound.

3. Do not permit the compound to burst into flames because burning consumes the oil in the compound. Loss of oil impairs its effectiveness. Too-rapid heating and too-high temperatures cause the compound to catch fire.

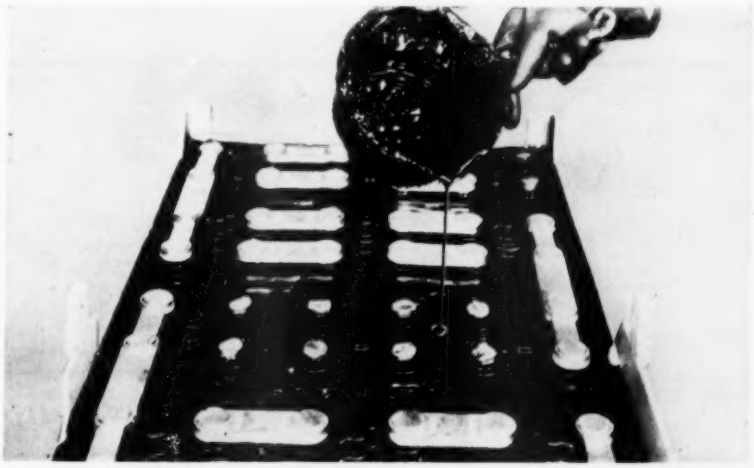
4. Almost any metal saucepan or aluminum coffee pot may be used to melt the compound. It is important, however, that the melting pot has a good pouring lip so that the melted compound can be directed into place accurately with a minimum of spilling on the cover.

5. Do not use too large a pot, because more time will be required to complete the melting than would be required for a smaller batch. A container holding about one quart generally is used. If some compound remains after pouring a seal, it may be cooled, stored and reused. However, when the compound is being reheated, do not puncture the unmelted top layer with a screwdriver or other pointed tool, because pressure in the lower section of melted compound may cause hot, melted compound to squirt up through the hole. The hands, face or body of nearby persons may be severely burned.

6. Clean the surfaces to be sealed, neutralize with ammonia or baking soda, and dry all surfaces carefully.

7. Be sure the cover is properly seated on top of the cell and is level with other cell covers in the battery.

8. Pour the sealing compound into space between the cover and the jar, being careful to avoid spilling. It is important to fill the space to the same level as the other cells in the battery so that there are no recesses where acid spray can collect. Use a sharp compound knife to smooth over rough spots and to remove excess compound after the compound has solidified.



Molten sealing compound is poured into the space between the cover and the jar. The space always is filled to the same level as the other cells in the battery to eliminate any acid-spray-collecting cracks

Questions and Answers

Your fellow engineers will answer your power plant questions. You answer theirs, get paid well. Simple? Effective? Why don't you try it?

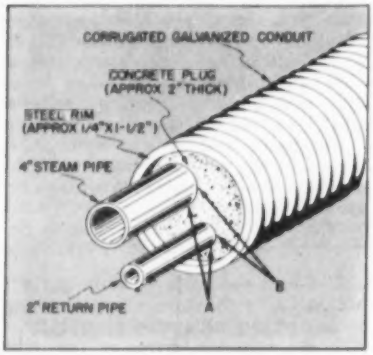
More Information on Question No. 509

How Repair this Leaking Pipeline?

SINCE THE July issue went to press, H.M.P. has sent us more information on his leaking pipeline. The pipeline is in galvanized, corrugated steel conduit which is buried about 24 in. underground. The conduit is packed with insulation which is retained by concrete plugs at either end of the section. Steam and return pipes rest on the bottom of holes through these plugs. All corrosion has occurred where the pipes were in actual contact with the plugs. In addition, an imperfect mastic seal between the plug and conduit caused similar corrosion of the conduit flange.

Sections of the prefabricated pipeline are connected by butt-welding the pipe joints, insulating the space between conduit plugs, and placing a clamping collar of metal around the conduit. The connection is then coated with an asphaltic material.

The accompanying illustration shows areas of major corrosion (A) and less severe corrosion (B).



Section of H.M.P.'s problem prefabricated pipeline

Question No. 510

What Is Wrong with this Engine?

ENCLOSED find indicator diagram of an engine driving beaters in a paper mill. Would you please analyze the same?

Monroe, Michigan — O. H. D.

Editor's Note: This old reciprocating engine is not doing its duty, obviously. It's a good chance for you old-timers to use some of that experience you've been building up over the years. O. H. D. will appreciate any comments which will lead to the elimination of those loops on both ends of the strokes and any other defects which you might see. So will we.

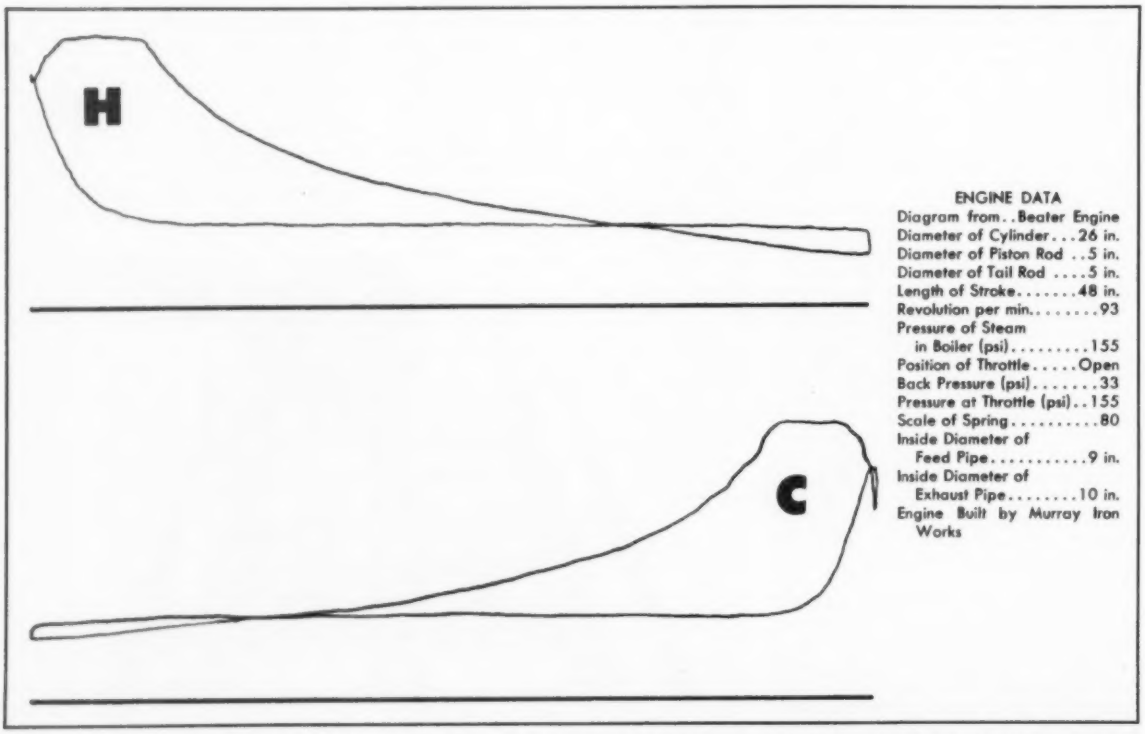
Question No. 511

What Causes Water Hammer in this Tail-Pipe?

SEVERAL MONTHS AGO, we installed a steam-jet refrigeration system with a barometric condenser. The barometric condenser and tail-pipe were installed as shown on the attached sketch. The usual secondary ejector and inter-condenser with a 3rd stage dry ejector are installed on the barometric condenser.

After start-up of the system, a distinct and loud water-hammer was present in the tail-pipe. The source of the hammer was believed to be in the immediate area of the 90 deg. base elbow. The water-hammer was not present when the vacuum in the condenser was less than 27.8 in. Hg, nor was it present when the steam ejectors were turned off and condensing water was allowed to run through the tail-pipe alone.

Except for this water-hammer, the operation and performance of the system were entirely satisfactory, but since a 27.8 in. Hg vacuum in the condenser was insufficient to provide the evaporator with the 29.75 in. Hg vacuum necessary to cool the chilled water to 40 deg. without changing the compression ratio of the steam-jets, we were faced with a choice of: (a) accepting the water-hammer, (b) changing the steam-jet in order to get an increased compression ratio, (c) moving the entire installation so that the tail-pipe would drop vertically for its



ENGINE DATA

Diagram from	Beater Engine
Diameter of Cylinder	26 in.
Diameter of Piston Rod	5 in.
Diameter of Tail Rod	5 in.
Length of Stroke	48 in.
Revolution per min.	93
Pressure of Steam in Boiler (psi)	155
Position of Throttle	Open
Back Pressure (psi)	33
Pressure at Throttle (psi)	155
Scale of Spring	80
Inside Diameter of Feed Pipe	9 in.
Inside Diameter of Exhaust Pipe	10 in.
Engine Built by	Murray Iron Works

Card and data from O. H. D.'s beater engine. Note the small loops on admission and the large loops on exhaust showed by both head and crank end cards

entire length from the barometric condenser to the hot well, or (d) changing the two 90 deg. ells to form a very slight angled change in flow at the bottom of the hot well.

Neither of the two solutions (b) or (c) were acceptable because of the expense of making either change plus the greatly increased operating expense if change (b) were made.

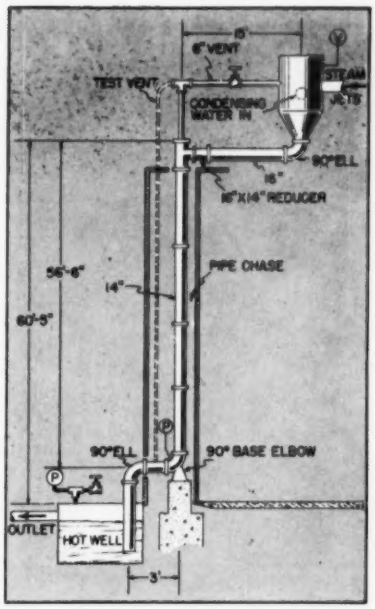
We believed the cause of the hammer to be due solely to the two 90 deg turns at the bottom of the tail-pipe, but also gave consideration to the horizontal run leaving the condenser. It was our belief that entrained air coming out of solution was being drawn back up the tail-pipe and since the deaerating would be more pronounced at the two lower 90 deg ells, as well as being below the water level in the tail-pipe, we felt sure that these air bubbles would form at the ells, grow larger with time and then be burst by the force of the dropping water, causing the hammer-like sounds. The hot well was originally sealed, but installing a valved vent with a pressure gage indicated that the hot well was not acting any differently from a normally open one.

The test vent shown dotted on the sketch was installed in an attempt to draw the air out of the tail-pipe as it escaped from the water. This was to no avail. The pressure gage installed inside the heel of the base elbow showed a pressure fluctuating between slightly positive and slightly negative. These pressure changes could not be synchronized with the "hammer". The 6 in. vent shown at the top of the tail-pipe was originally a 2 in. vent. Increasing this vent had no effect on the hammer.

In addition to the possible solutions mentioned above, two other means to remove the "hammer" were suggested: (1) Install a larger barometric condenser, and (2) restrict the flow of condensing water at the hot well outlet, thus causing the water-level in the pipe to rise and decrease the free fall height of water, as well as raise the level in the pipe where the vacuum changes to atmospheric pressure or higher.

We would appreciate the opinion of your readers as to what is causing the water-hammer and how it can be eliminated.

E. E. M.



Answer to Question No. 507

Expansion Joints vs. Expansion Loops

Use Joints to 300 psi, Says de Soto

CORRUGATED EXPANSION joints find their best applications where pressure does not exceed 300 psi and temperature does not exceed 400 F. They are very valuable in pipe runs in confining conduits or where straight runs between rigid connection points are necessary.

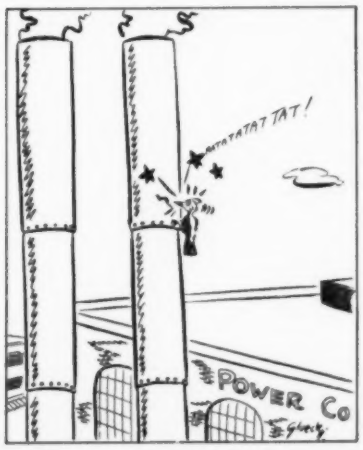
Economies resulting from the use of expansion joints, as compared to expansion loops, are:

1. Reduced heat losses, since there is less outer surface.
2. Lower friction losses.
3. Low material, fabrication and installation costs.
4. Saving of space.
5. Less insulation required. Both the expansion joint and the expansion loop will have long life if properly installed.

Expansion joints made of special alloys and from special designs raise the temperature and pressure limitations to as high as 1400 F and 1500 psi. Other designs accommodate lateral as well as lineal expansion.

In conclusion, let us say that for 30-psi and 175-psi steam lines the use of the corrugated expansion joint is economical; for 300-psi and above, pipe bends and expansion loops are a necessity and proven practicality.

Philadelphia, Pa. HENRY DE SOTO



Question No. 512

How to Figure Pneumatic Conveyors?

RECENTLY I TRIED to find some design data on pneumatic conveying systems for wood waste and was surprised to find that it got very meager treatment in the handbooks. The minimum velocity for various materials was given in most of the handbooks, but none of them gave the relation of blower output to the weight and volume of material handled.

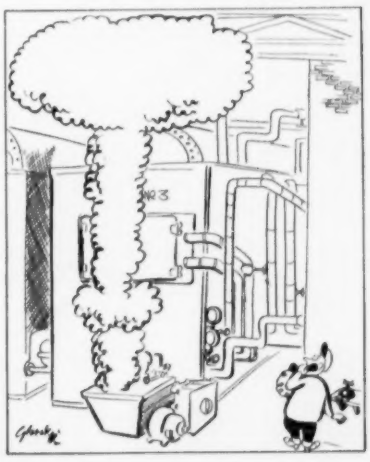
We produce sawdust (green southern pine) at a maximum rate of about 280 lb per minute. That amounts to about 7 cu ft of solid wood converted into dust each minute, and this averages out at 40 lb per cu ft. These figures, incidentally, are for steady operation at the maximum rate. The daily average is more like 80 percent of the amounts noted, but the system would have to be designed to meet the maximum requirements.

While going through the books on this system I ran across a reference to the use of steam eductors in place of the air compressor. Since we fire our boilers with this sawdust, would a steam system make the sawdust too wet for fuel? Also, since the pine sawdust is rich in resin, would the steam cause resinous deposits in the ducts? Our steam and water supply would be adequate since our boilers are "loafing" under present loads.

We plan to install the system in a steam sawmill of overhead or "upstairs" construction. We have plenty of room to provide gradual bends everywhere except under the head saw, and plan to have a cyclone separator over the boiler house. The duct will have to run between 75 and 100 ft, depending on the location of the cyclone.

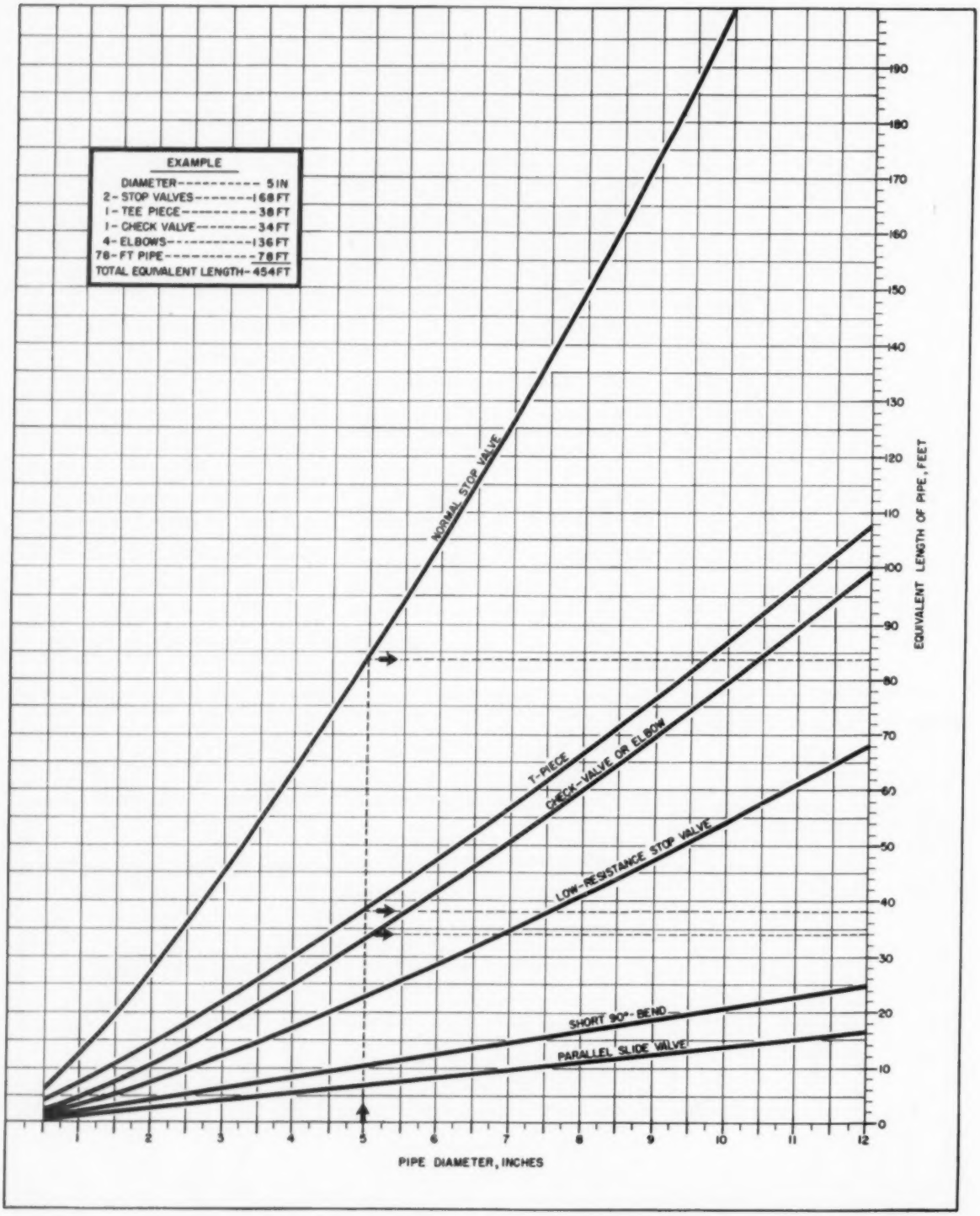
How do we figure the capacity of the blower? We can always get one "big enough" but dislike buying unnecessary capacity.

R. J.



Equivalent Pipe Length Chart for Figuring Pressure Drops

Do you ever have to calculate pressure drops in steam lines? Here's a useful chart for your files. It gives equivalent pipe lengths of standard bends, elbows, tees, and various valves for pipe sizes up to 12 in.



Courtesy *The Steam Engineer*, London, England. Copyright in Great Britain by W. Goldstern.

Air Conditioning . . . What Got Left Out?

Buyers who prefer cheapness to quality and sellers who cut corners are both to blame for many faulty air conditioning installations, and here's proof of it

By C. T. BAKER
Consulting Engineer

DURING THE PAST FEW years I have been called upon to investigate a number of air conditioning plants that were not performing according to the promises and guarantees of the installation contractors.

In fairness to the seller-contractor of a number of the plants inspected, it should be stated at the outset that in many instances failure to perform was due to the short-sightedness and false economy of the buyer who was blind to everything but the "low bid."

How to Disgruntle Customers

Here are a few examples of the kind of propositions that ensure disgruntled customers:

"I want to air condition my place of business, but I don't want to spend much money."

"You will have to put all the equipment in one corner of the basement; I know there is not much room, but Blank and Co. say they can get their equipment in there and do a satisfactory job too."

"Why do you need new duct work — why can't you connect the chilled air supply to the same system of ducts that supply warm air in winter? If these ducts are large enough for hot air, they should work with cold air."

"If you want this job, have your pencil sharpened — I'm going to award the contract to the low bidder."

These, and other equally bad conditions which many buyers of air conditioning installations lay down as law in dealing with the seller, cause no end of trouble, and the results often lead to the courthouse. On the other hand, many failures of air conditioning plants are caused by the eagerness of the sales engineer to make a sale, even in the face of conditions he knows will cause trouble later on.

It is not hard to understand why it is difficult for the legitimate contractor to obtain business in competition with the boys who tell the prospective buyer, "Let us do the job for you and we'll save you money." But it is surprising to see how many business men still fall for this time-worn, moth-eaten line. That they still do is illustrated clearly by the following example.

The Case of the Skeleton Plant

I saw this installation several weeks after it had been placed in service. It was a 30-ton plant which had one compressor, a condenser, and one direct-expansion-type air handling unit. I examined the proposals which had been submitted to the owners by four bidders. Of course, the low bidder had been awarded the contract. The following list shows what had been left out of the installation by the successful bidder, but which had been included in the proposals of the other three bidders:

1. No liquid Freon receiver had been provided between the condenser and the evaporator.
2. No pressure gages were installed to indicate the suction and discharge pressures.
3. There was no by-pass around the Freon dryer in the main liquid line.
4. No strainer had been put on the outlet of the dryer.
5. There was no stop valve on the compressor discharge line at the condenser.
6. The belt drive between the motor and the compressor had no metal guard.

Obviously it is not difficult to be the low bidder when figuring on furnishing a skeleton plant only, while conscientious competitors, realizing how necessary this equipment is, include such items in their proposals.

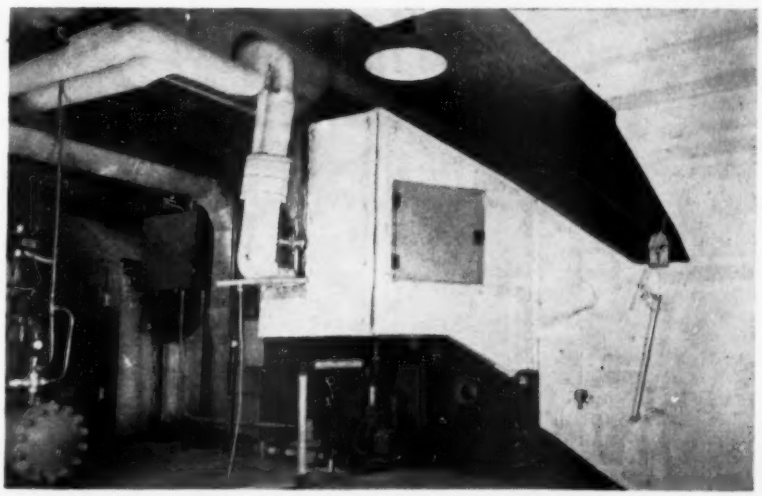
Without gages, no one knows the suction and condensing pressures. The contractor tells the buyer: "You don't need gages; when you want to know your operating pressures, call us and we will send a serviceman with instruments for checking." This extra service is, of course, paid for by the owner.

As for keeping the dryer in service at all times — which is necessary when it is not placed in a by-pass duct — this method, to say the least, is inconvenient, as it allows no opportunity for changing the drying agent without shutting down the plant. In some instances, the inlet and outlet pipes to the dryer have no stop valves, with the result that even though all the other valves in the system are closed when the charge of drying material is being renewed, much of the piping system fills with moisture-laden air.

The Case of Excessive Fuel Bills

A multi-story office building installed a year-round air conditioning system. The units — one on each floor — were supplied with chilled water from a central refrigerating plant in summer and with hot water from a central heating plant in winter. Each unit, fitted with both cooling and heating coils, was housed in a small room, about 8 by 10 ft, fresh air for ventilation being brought in through the outside wall of each enclosure. On the separate floors, return air from the various offices reached the room housing the unit via the

(Continued on page 118)



Small installations like this one are most likely to suffer from the various troubles described by the author

Advances in the Design of Large Turbine Generators

Expansion of present day power systems justifies use of continually increasing single blocks of power. Outstanding technical advances in turbine generator design makes it possible to obtain blocks of power from single generators of 250,000 kva capacity or higher

AMONG the many papers of interest at the American Power Conference in Chicago in March was a group of three papers all devoted to a discussion of recent advances in the art of large electric generator design. These papers were of particular interest because they were presented by representatives of the three large turbine generator manufacturers in this country, i.e., General Electric, Westinghouse, and Allis-Chalmers, and showed how each of the companies are meeting the continually increasing demand for larger generating units.

The increase in generator ratings has been phenomenal. It is only about 25 years ago when a 35,000-kw turbine generator was the largest unit in existence. Today, we have machines of 250,000 kw on order and the manufacturers are ready to build even larger units.

Progress in generator design has been steady during the past quarter of a century but it has been more rapid during the last five years than at any time in history. While it has been possible for over 20 years to build 1800 rpm generators of the largest sizes needed, the construction of 3600 rpm machines were a challenge to the designers. Many problems had to be solved before 3600 rpm units of large size became possible. As pointed out by Messrs. Kilbourne and McClure of General Electric Co. in their paper, these problems involved the removal of a number of basic physical limitations in several areas of engineering. These can be listed as follows: Magnetics — how to carry more flux; Electricity — how to conduct current better; Dielectrics — how to contain voltage better; Fluid flow and thermal dissipation — how to convey heat; and finally, Mechanics — the development of methods and techniques of construction to achieve these improvements.

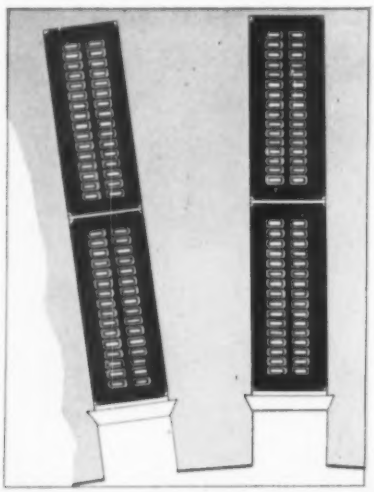


Fig. 1. Cross section of the armature bars suitable for the General Electric Co. internal liquid cooling system. Coolant flows through ducts in the copper

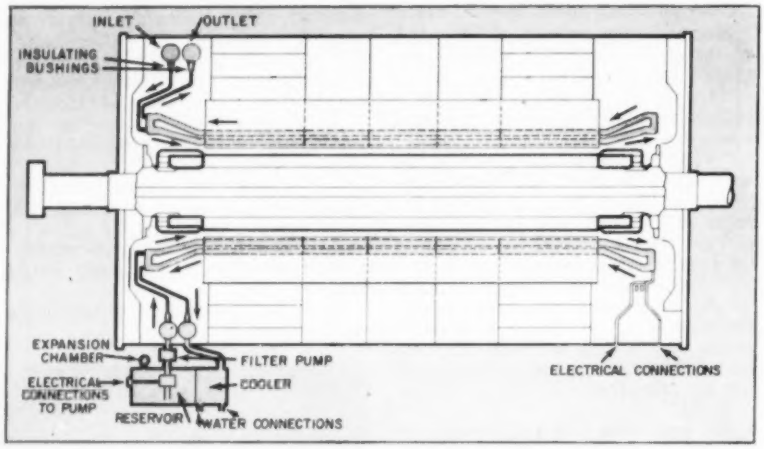


Fig. 2. Schematic diagram of the G-E liquid-cooled generator showing flow of coolant in unit

In the field of magnetics there were two major problems, first that of the rotor, and second, that involving the armature or stator. The rotors of large generators are now generally made of solid steel forgings. From the beginning it was always essential that the rotors have high, uniform physical strength. This called for alloy steels, principally nickel, with some additions of chromium, molybdenum and occasionally vanadium, and elaborate heat treatment. This processing often resulted in considerable variation in the magnetic characteristics of different rotors. Further research, however, disclosed that careful control of the carbon and chromium content plus revised heat treatment, not only provided excellent physical properties but also superior magnetic quality.

A similar development took place with respect to the magnetic parts for the armature. In this case oriented-grain strip steel has replaced the formerly used non-oriented steel with a substantial reduction in the magnetic losses.

Improved Electrical Conductors

High rotor speeds with consequent increasing centrifugal stresses made it necessary to develop new conducting material in place of the soft annealed copper which had given adequate service in machines of lower

speeds. This situation was met some 12 years ago by the introduction of cold worked silver bearing copper. The use of this material has been very successful and it is used today on all generators, 1800 and 3600 rpm units alike. In the meantime, however, it became evident that the use of a material lighter than copper would be desirable in machines of very large rating. The reason for this is the fact that the diameter of a rotor largely is determined by the thickness of the steel end rings which hold the rotor conductors in place against the high centrifugal forces of rotation. About 15 years ago, therefore, aluminum was used for field windings. This created marked improvement in retaining ring stresses but the early aluminum, like the early copper, was soft and did not, and could not be made, to withstand the high stresses that would be set up in larger machines which would have to be built. An extensive research program therefore was set up to improve the physical properties of aluminum without impairing its electrical conductivity. Eventually an alloy was developed which had the required physical and electrical properties, and this now is known by the name of Cond-Al — Conductor Aluminum. This material now is being used in large diameter 3600 rpm rotors. The earlier developments in magnetic materials set the horizon with regard to generator size at 180,000 kva. Cond-Al together with certain constructional changes now has moved the horizon to 220,000 kva capacity range.

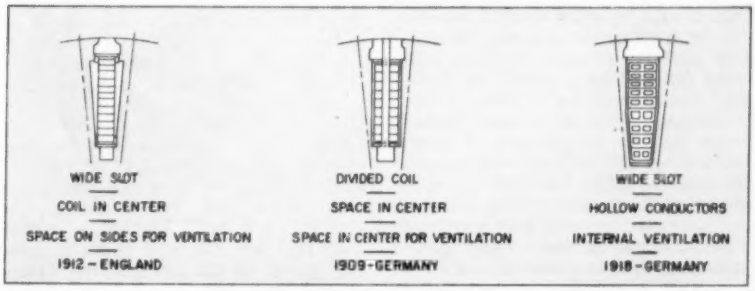


Fig. 3. Early types of slot arrangements for direct cooling of rotor coils for various turbine generators

Heat Removal

Despite the use of more effective magnetic and electrical material, the most important factor in generator design involves the removal of heat. While modern turbine generators are extremely efficient, it requires only simple arithmetic to prove that a 200,000 kva generator having an efficiency of say 99 per cent still would produce some 4000 kwh of heat every hour. The continuous removal of this heat constitutes a difficult problem.

In the early days the problem was relatively simple. Machines were small and generously designed, and the natural radiation and convection from the surfaces was sufficient to keep the temperature of the windings and magnetic structures down to a safe level. As generators became larger, forced air cooling became necessary and in time closed air-cooled ventilating systems came into use. The use of air cooling was followed by hydrogen which was lighter than air and also had better heat absorbing properties.

While the use of hydrogen in closed cooling systems greatly extended the generator designer's range as far as generator design was concerned, it brought into prominence the limitations of the electrical insulating materials which were used on the windings. It is obvious that all the heat generated in the conductors must pass through the insulation before it can be removed by the cooling systems. Unfortunately, most good electrical insulators are also fairly good heat insulators, and so the insulation on the generator windings acts to form a thermal barrier between the conductor and the cooling system.

Obviously, one way of decreasing the temperature difference between the conductors and the magnetic structure which holds the conductors in place is to reduce the thickness of the insulation. This means lower voltages, and in large machines this means special winding arrangements. On 3600 rpm machines 2-circuit windings have been in use for years and recent developments make it possible, for certain limited voltages, to make these windings in 4 circuits.

While such special windings have proved very effective in certain cases, they have the disadvantage of producing high line currents. For example, for a 300,000 kva machine at 15,000 v, the line current would be 11,560 amp. This is a higher current than can be carried by present single bushings but it could be carried by parallel bushings and bus arrangement presently available. According to Mr. Kilbourne of General Electric, single bushings for such currents also are expected to be available in the near future.

These developments indicate that the resources of the generator designers have not been depleted entirely but the trend towards still larger generating units has led to several new approaches in generator design. All of these aim at the elimination of the thermal drop through the insulation by means of internal cooling passages in the conductors.

A system of this kind first was built into a large turbine by the Allis-Chalmers Co. in 1951 and this machine was the basis of the paper by Wm. Ringland and L. T. Rosenberg of Allis-Chalmers at this American Power Conference meeting. This generator, installed at Sheboygan, uses what the Allis-Chalmers Co. calls supercharging. This supercharged machine has a 2-stage compressor mounted on one end similar to an aircraft supercharger. Developing several times the maximum fan pressure previously used on this type of machine, the compressor forces the hydrogen at high velocity through ducts in the rotor copper. The high pressure and consequent high gas velocity play an important role in the effectiveness of heat removal.

This idea of internal cooling of the conductors, by the way, is not new. As indicated by Mr. Kilbourne in presenting the General Electric paper, divided coils and hollow conductors for rotors were used in Germany as early as 1912 and 1913.

Cooling Methods

As described in the papers by the General Electric Co. and Westinghouse Electric Corp. engineers at the meeting, both of these companies also are using or planning to use the hollow conductor method of cooling either for the rotor or the stator conductors alone or for both. Westinghouse already has built machines using such hollow conductors with hydrogen gas as the coolant. The Westinghouse system was described in a paper presented by J. W. Batchelor. In the Westinghouse design in the rotor winding, ducts are formed in the copper straps. Gas enters these ducts by means of radial holes at the ends of the rotor and it is discharged at the center through similar holes. The stator winding differs slightly; in order to reduce the eddy current losses, the conductors are divided into a number of small strands insulated from one another, but to provide room for the gas flow, the strands are separated widthwise in the slot by metal ducts which extend from each end of the coil. Because of the eddy current losses, these ducts also must be insulated the same as the strands in the winding.

By eliminating the temperature drops through the insulation and the steel by the use of these hollow conductors, the effectiveness of increasing the gas pressure can be improved greatly. If such a generator were to be designed for operation at 0.5 psig to match a given turbine rating, its capability would greatly exceed that of the turbine. If, however, the design is based upon higher gas pressures, the capability may be made to match that of the turbine and, at the same time, advantage can be taken of the greater heat dissipation qualities to reduce the size and weight of the generator.

Another approach to internal cooling is to circulate a cooling liquid

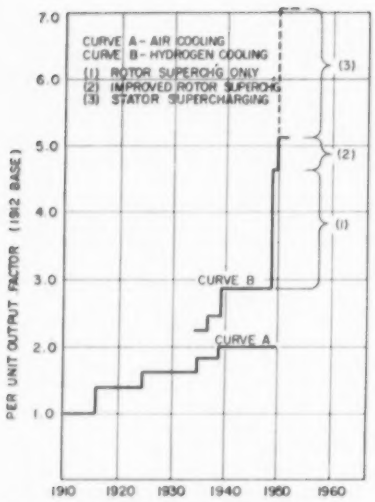


Fig. 4. Various steps in improvement of large a-c generators. From Ringland and Rosenberg's paper

through the conductors instead of a cooling gas. The accompanying diagrams show details of conductors and a machine designed for liquid cooling by the General Electric Co. These are for liquid cooling of the armature, i.e., the stator. The cooling liquid enters the turbine end of the bar through a manifold, which in principle is very much like the manifold headers used in conventional heat exchangers. It flows through the bar to a similar header on the other side, from which it either may be collected and put in an outside circuit, or as shown in this diagram, returned through another bar to the end of the machine at which it entered. There will be two ring headers as shown in Fig. 2, one for the cool liquid and the other one for warm liquid, each going completely around the armature winding. Each header will have mounted on it a number of insulators which have tubular center passageways. Each insulator will in turn have a metallic tube connecting it to one of the headers on the ends of the armature bars. As shown, the external circuit contains a storage tank, cooler, and pump to provide for cooling the fluid and to produce the pressure required to circulate the fluid through the windings.

The liquid cooling scheme is the most powerful cooling means yet conceived. It is very efficient as far as losses are concerned. Contrasted with the several hundred kilowatt loss in the multi-stage fan necessary to circulate gas in the gas-cooling systems, the liquid will require several horsepower, not hundreds of horsepower, in the circulating pump. The disadvantages are, obviously, in the details of the plumbing necessary to contain the liquid. While the General Electric engineers admit that these certainly are not small, the engineers say that they can be taken care of adequately in designs now in progress.

Of considerable interest at the meeting of the American Power Conference where the papers discussing these designs were presented, was the discussion by Carl J. Fechheimer of Milwaukee. Long recognized as an authority in the field of generator cooling system design and for many years with Westinghouse, Mr. Fechheimer's interest in cooling methods extends over a period of many years. As he pointed out at the beginning of his discussion, he had helped start the campaign for reduction in the size of large generators. The idea of using hollow conductors with the coolant in contact with the conductors, said Mr. Fechheimer, is old but recently it seemed to him to have taken generator designers by storm. For many years he had been an ardent advocate of liquid cooling, and he referred to his two papers on liquid cooling published in the AIEE Transactions in 1947 and 1950.

In commenting on the three papers, Mr. Fechheimer did not think that it was wise to reduce the conductor cross section in order to make way for the coolant, when at the same time the greater loading due to the increase in rating for given dimensions is accompanied by much greater losses in the conductors. Furthermore, even though valuable conductor space is taken for the coolant, he felt that the space for the coolant is too restricted for very long machines. Thus, even with supercharging, the emerging coolant temperature is too high. Mr. Fechheimer noted that in the paper by Ringland and Rosenberg, in one case, the emerging gas temperature in the rotor was around 90 C.

The expansion and contraction problem, said Mr. Fechheimer, has not been eliminated in these new designs. The tendency evidently was to reduce dimensions by running the temperature of the conductors to about the same value as in conventional machines so that there is about the same temperature difference between the steel and copper as before. Hence, there is the same differential expansion for a given length of core as in earlier machines.

With the coolant inside the stator coils, it seemed to him that the eddy current loss must be high, and that while transposition schemes might be used with the Kilbourne design, the hollow strands would be so deep that a large strand loss would prevail. Also, even with internal coolant flow in the stator coils, it still is necessary to cool the stator teeth and core by hydrogen, and the schemes for cooling the rotor conductors are complicated.

In contrast to the methods of cooling described in the three papers presented at this meeting, Mr. Fechheimer called attention to the liquid-cooling scheme proposed in his AIEE papers presented in 1947 and 1950. In the 1947 paper, the stator insulation was immersed completely in a high grade insulating liquid, as in a transformer. The insulating wall thickness then can be reduced materially. Then, also, the copper section can be increased; the dreaded temperature difference between the copper and the steel can be decreased, and at the same time the machine's dimensions can be reduced. He pointed out that his rotor model tests had demonstrated that the cooling water for the rotor in the Fechheimer scheme could be passed through ducts in the rotor teeth, and almost eliminate all thermal drops, except that in the insulating wall, which meant, of course, that consideration must be given to the possibility of thermal expansion and contraction. This, he thought, might be taken care of by silver bearing copper.

While Mr. Fechheimer's comments on the three papers were critical, he was gratified to know that liquid

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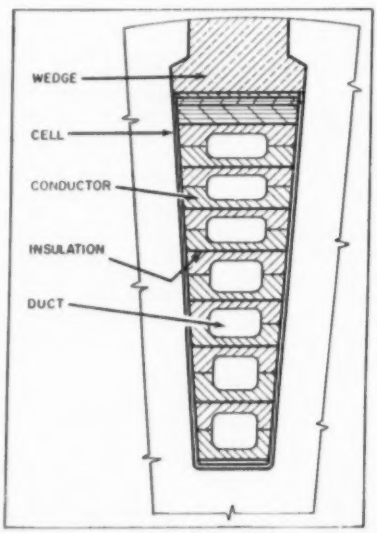

Fig. 5. Westinghouse design for inner-cooled rotor coil to use for large hydrogen-cooled generator unit

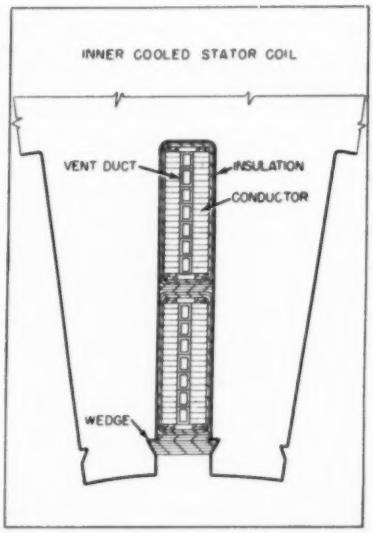

Fig. 6. Westinghouse design for inner-cooled stator coil to use for large turbine generator unit

LETTERS TO THE EDITORS

Burning Pitch

I READ Mr. Miller's excellent article on the burning of petroleum pitch in the June issue, with great interest because I had some experience in Great Britain during the war in the burning of coal tar pitch.

Attempts were made then to burn some of the heavy distillates from the distillation of coal. These fuels were graded according to their required atomization temperature. Thus, Coal Tar Fuel 400 was a medium-soft pitch which required a temperature of 400F for efficient atomization.

This fuel was black, fusible, but normally solid and could be fractured at ordinary temperatures by a sharp blow. Its ash content was 0.75 per cent; sulphur, 1 per cent; heat value 16,000 Btu per lb.

The fuel was supplied either in solid form, the lumps ranging in size from about an 18-in. cube downwards; or, more rarely, in liquid form, at temperature no lower than 300F. The fuel is stored and pumped at the same temperature. Subsequent heating to the atomization temperature of 400F was done either by steam requiring a pressure of 350 psi or electricity. Care had to be taken that the temperature did not exceed 575F because of changes occurring to the physical properties of this fuel. The fuel usually was circulated through a ring main, and steam or hot-air atomization was used.

Using coal tar pitch usually required considerable maintenance and care of burners, pipelines, and heaters. It was interesting to read that you were doing a good job on a similar fuel. Of course, the fact that you have standby Bunker C oil in hand, always ready for use, must be an important factor in keeping your plant going.

Columbus, Ohio CHARLES H. MARKS

Editor's Note: — Mr. Marks is development engineer in the Columbus office of Bituminous Coal Research, Inc.

How About White Paint for Heat Absorption?

L. G. JONES, in his articles on Paint Reflectivity (Dec., 1952) and Heat Absorption (Feb., 1953), concludes, on the basis of his tests, that the metallic paints, such as aluminum, are the best surface colors for tanks that hold vaporable liquids, such as propane, gasoline, etc. While he did not personally test white paints, his data places the metallic paints above the white paints in reflectivity and heat absorption.

PROPERTY	TIME OF EXPOSURE	NEW ALUMINUM	CHALKING WHITE	RATIO
Volume of vapor lost	12 days	193 mcf	148 mcf	1.3
Per cent expansion, vapor phase	12 "	6.4%	4.7%	1.4
Gasoline lost as vapor	12 "	46 bbl.	28 bbl.	1.6
Over-all liquid loss	18 "	110 bbl.	77 bbl.	1.4

Smith and Harden of Shell Oil, in their article in *Oil and Gas Journal* of July 14, 1952, indicate a preference for chalking white paint over aluminum for coating such tanks. They took a plant operating approach to the problem, rather than laboratory tests, by determining actual evaporation losses, vapor and liquid temperatures in drums, 1000-gal cone-top tanks and a large 80,000-gal storage tank.

The accompanying chart summarizes the relative positions of new aluminum, weathered aluminum and black, to chalking white, with reference to several of the criteria that seemed to be significant. Weathered aluminum seems to average about 1.7 to 1 for the chalking white. The non-chalking white paint was not nearly as good as the chalking or self-cleaning type.

A summary comparison of the ratios of new aluminum to chalking white paint pointed to the results shown in the table.

In the writer's own experience in the north central states, aluminum coatings always have been preferred for such tanks by all of the oil companies. The use of white paint generally has not been adopted, but the data of Smith and Harden indicate that further study is well warranted.

Ohio WRIGHT M. FEDDER

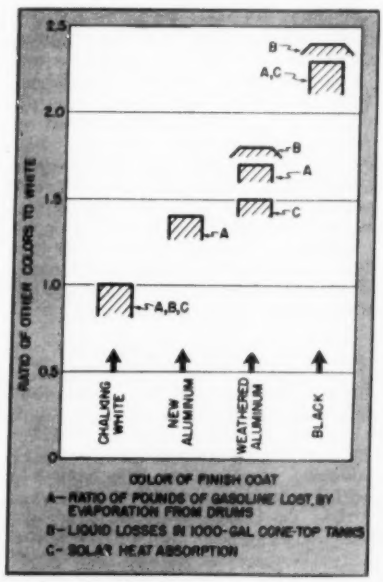

Diagram by Fedder showing comparison of aluminum to chalking white paint and black paint

Saving Piping $ $ $

MY ARTICLE Save H-P H-T Piping $$$, in the May issue evidently has gotten through to several important power engineers the realization of how some important savings can be made along the lines I indicated.

Among other comments, I have been reliably informed that a large utility company in the East, after reading my observations, made a review of the piping system for a new 200,000-kw plant it is designing. As a result, so I am told, several expensive valves, costing from $18,000 to $24,000 each, together with the planned access platforms, were eliminated from the design of the piping system.

Pennsylvania HENRY DE SOTO

Entirely Unsolicited

HAVING RECENTLY been given a copy of your June issue of POWER ENGINEERING, may I take the opportunity to commend you on the fine magazine that it is. I found the feature articles interesting and informative, and the ads also were in good taste.

New York EDWARD M. ELLIOTT

Editor's Note: — Our deepest salaam to Mr. Elliott, who is an engineer with Ebasco Services, Inc.

Red Face Department

Fire Extinguishers

MAY WE CALL your attention to an apparent error in your May issue? On page 63 you cite a survey of the National Fire Protection Association on the popularity of fire extinguishers. In it no mention is made of vaporizing liquid extinguishers for Class B and C fires.

Inquiry of the National Fire Protection Association reveals that no survey of this nature was made and they advise that the probable source of the news item was published correspondence between a member of that association in Australia and a staff member of NFPA. After stating that the best selling extinguishers in this country were "carbon tetra chloride (vaporizing liquid), soda acid, carbon dioxide, dry chemical" in that order, the NFPA staff member went on to give a personal opinion on other types, which omitted reference to the vaporizing liquid units.

Our reason for calling this to your attention is that the vaporizing

(*Continued on page 120*)

Fig. 1. View inside furnace, showing three overfire air jets in one corner

Fig. 2. Typical overfire air damper installed in cutaway forced draft duct

Overfire Air Limits Underfeed Stoker Smoke

This article describes how a badly smoking underfeed-stoker-fired boiler was completely cured by the addition of an overfire air system

SMOKE IS FORMED when hydrocarbon vapors, heated to high temperatures without enough oxygen to burn them, decompose to form finely divided carbon or soot particles. This form of carbon is very difficult to burn, so the first principle of smoke abatement is not to try to burn smoke after it is formed, but to prevent its formation in the first place. For this reason it is necessary to mix oxygen with the vapors as they are formed. In practice this is done by injecting streams of air across the top of the fuel bed. When a concentration of smoke comes from some particular part of the furnace, the overfire air should be directed to those points.

Ash Grinding

This method is illustrated well in Fig. 3, a diagram of one half of a double-ended Taylor underfeed type stoker at the Connors Creek Power Plant of the Detroit Edison Co. Heavy smoke occurred during and immediately after ash grinding, and most of the smoke came from points A and B; from A because the break in the fuel bed let a rush of excess air through the break, causing the adjacent fuel bed to smoke heavily because it did not get enough air. At position B, the grinding operation caused large chunks of the fuel bed to break loose and fall into the pit. When this happened, the chunks would hit the bottom of the pit, smash into pieces, and release large quantities of hydrocarbon vapors. Puffs of smoke occurred immediately, because insufficient air was available during this short interval.

Location of Jets

To overcome this difficulty, overfire air jets were installed, as described in detail by James W. Campbell and Richard J. Travis of the Detroit Edison Co. before the ASME Spring meeting. Each of the nine boilers to which this overfire air system was added had a normal capacity of 330,000 lb per hr, with turbine throttle steam at 600 psi and 825F. Combustion chamber heat release at maximum capacity (420,000 lb per hr) is 50,800 Btu per cu ft per hr, and maximum coal burning rate is 91.8 lb of coal per sq ft of grate area.

The jets were located where they would direct extra air to the points producing the smoke, i.e., A and B in Fig. 3. The jet positions are shown in the plan of the furnace in Fig. 4.

Source of Overfire Air

In order to get air to these jet locations it was necessary to blow it between the waterwall tubes. To do this, fins and protecting blocks were removed from between the waterwall tubes, and the air jets were located 12 to 14 in. above the normal top of the fuel bed. If they had been installed closer to the fuel bed, clinker might have been formed by the cutting and scrubbing action of air on the fuel bed. Boiler wall downcomer tubes also had to be rerouted. Each air injection point had three jets, as shown in Fig. 2.

In this particular installation, the four ducts that carried the forced draft preheated air down to the plenum chamber passed close to the proposed jet locations, so it was fairly

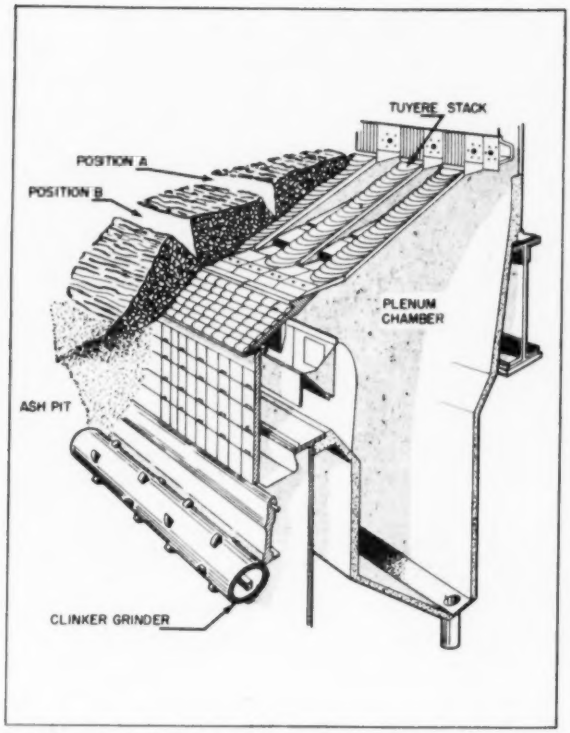

Fig. 3. One side of fuel bed and furnace showing critical smoking positions

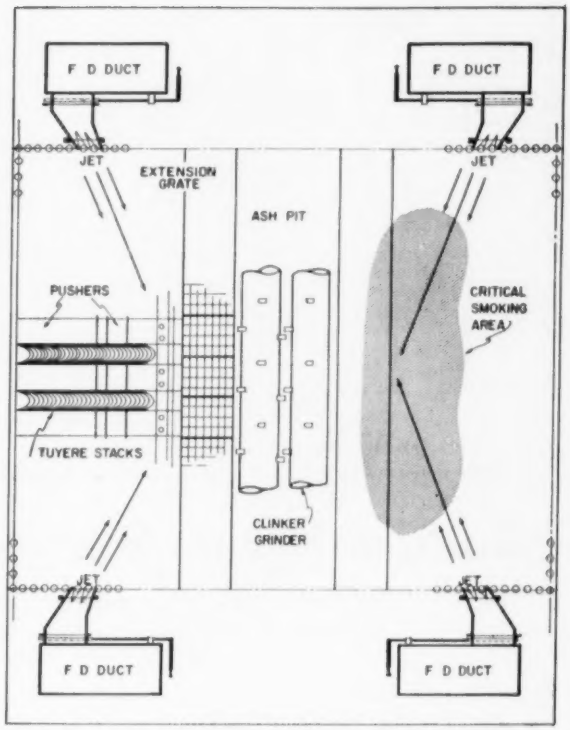

Fig. 4. Plan view of the furnace showing the air jets and critical smoking area

easy to install an overfire air damper in each duct. The damper scoops out a portion of the air flowing downward through the duct to the plenum chamber and projects it through the jets into the furnace. Each damper is controlled manually by a lever located near where the fireman looks for smoke. By adjusting the lever he lets in enough overfire air to eliminate excess smoke.

Twenty per cent of the theoretical air necessary for combustion can be put through the four overfire dampers when the forced draft pressure is 4½ in. water. Each damper is 12 in. high by 24 in. wide in a duct 6 ft wide by 2 ft 4 in. deep. There are three jetsat each corner, and each jet is 2⅜ in. wide by 9 in. high. The total jet area at each location is about 60 sq in. With 4½ in. water pressure in the duct and the damper fully open, the initial velocity of the air through the jets is about 10,000 ft per min.

Installation Tests

When the installation was completed it was tested thoroughly. The fuel beds in the two-sided furnace were made very heavy by overfeeding the coal, and they then were disrupted by excessive ash grinding. This caused the fires to become very heavy and smoky. By opening the dampers 10 per cent, the smoke was almost eliminated in a few seconds. With this small damper opening, there was still an occasional puff of smoke due to the large chunks of coal falling into the pit. Later a test was run with a steam flow of 300,000 lb per hr, and with the stokers overfeeding 30 per cent and excessive ash grinding.

With the dampers closed, No. 4 Ringleman smoke (80 per cent density) was leaving the stack in a steady stream. This smoke was eliminated completely when the overfire air dampers were opened 25 per cent. This operation was repeated successfully several times. Not only is the overfire air a cure for smoke coming from specific locations, such as breaks in the fuel bed, but it also will cure a smoky condition that exists over the entire fuel bed. On another test, such a condition was cured by opening the dampers on one side only of the furnace. These two dampers were opened about 20 per cent. In every test, smoke was eliminated or reduced to a negligible intermittent puffing.

Overfire air penetration was observed through inspection doors above the fuel bed. The length of penetration appeared to be at least 10 ft across and about 4 ft above the fuel bed. This was about half the furnace width.

The amount of overfire air was determined in the following manner. An air flow meter fixed the total air flow as measured by the pressure drop through the economizer. Three indicating air flow meters in each of the two plenum chambers gave the approximate air flow through the fuel bed. This was fixed at a steam flow-air flow chart reading of 315,000 lb per hr. The air flow through the plenum chamber was assumed to be 100 per cent of the total air flow with all the overfire air dampers closed.

The overfire dampers then were opened a fixed amount, and the air flow was readjusted to a chart reading of 315,000 lb per hr. Naturally the air flow through the fuel bed decreased. The difference in air flow was assumed to flow through the overfire air dampers. Although not strictly accurate, the test readings obtained with this method agreed favorably with design calculations.

The overfire air system described here already has been installed on nine boilers and has proven completely successful in reducing smoke from each one.

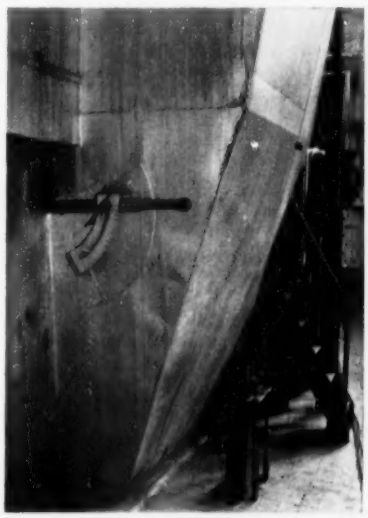

Fig. 5. Lever for operating damper shown in Fig. 2

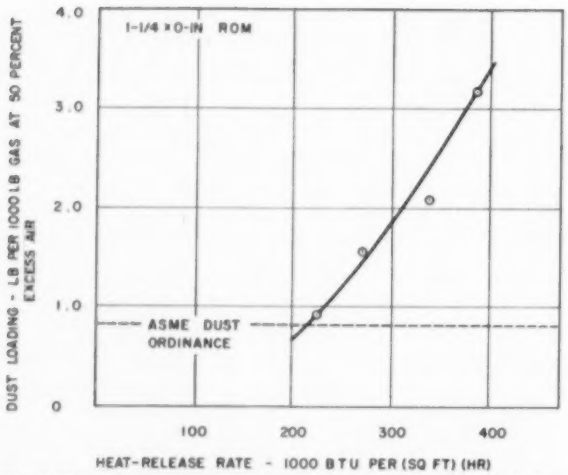
1-1/4 x 0-IN ROM
ASME DUST ORDINANCE
DUST LOADING - LB PER 1000 LB GAS AT 50 PERCENT EXCESS AIR
HEAT-RELEASE RATE - 1000 BTU PER (SQ FT) (HR)

Fig. 1. Effect of heat release rate upon dust loading for one of the boilers

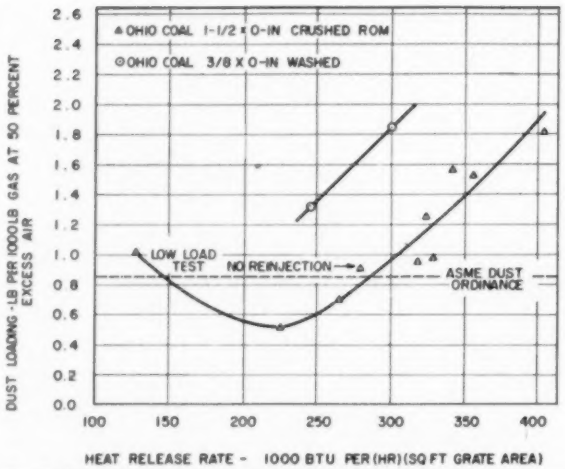
▲ OHIO COAL 1-1/2 x 0-IN CRUSHED ROM
⊙ OHIO COAL 3/8 X 0-IN WASHED
LOW LOAD TEST
NO REINJECTION
ASME DUST ORDINANCE
DUST LOADING - LB PER 1000 LB GAS AT 50 PERCENT EXCESS AIR
HEAT RELEASE RATE - 1000 BTU PER (HR) (SQ FT GRATE AREA)

Fig. 2. Shows the effect of coal size and heat release rate on dust emission

Reducing Dust from Small Spreader Stokers

Tests on small spreader stoker boilers determine the relation between dust emission and coal size, heat emission, excess air and type of control

WITH THE GROWING NEED to reduce air pollution, there has been increasing interest in the problem of collecting fly-ash and cinders from coal-fired boilers. Before preventive measures can be taken, it is necessary to know the amount of dust emitted and what is causing this emission. Practically no information of this nature has been available for small spreader stokers, so the data contained in a recent ASME paper by Elmer J. Boer, of Bituminous Coal Research, Inc., and Charles W. Perterfield, formerly research engineer, Battelle Memorial Institute, are particularly welcome. These men conducted tests on four small spreader stoker installations and their results are summarized in the following way:

1. More dust is emitted from small spreader stokers as the quantity of fines in the coal is increased.
2. The dust emission from small spreader stoker fired boilers increases as the rate of heat release is increased.
3. A lot of excess air may increase the rate of dust emission. This excess air may result from improper air control or from a leaky boiler setting.
4. Modulating controls reduce the rate of cinder emission about 20 per cent compared with on-off operation. Modulating controls, among their other advantages, reduce the maximum velocities attained in the furnace and gas passages.
5. Spreader stokers require dust collectors when firing coal at high rates. The type of collector required depends on such things as coal size, rate of heat release, type of combustion control and excess air. However, at heat release rates below about 315,000 Btu per sq ft per hr, it is possible to stay below the emission allowed in most ordinances if the spreader stoker is properly operated and a double screened or washed coal, in which the minus 48 particles are eliminated, is burned.

The boilers on which this series of tests were made were a 202 hp Keeler, sectional header, cross-drum type; a 150 hp Keeler CP type; a 212 hp B & W Straight Tube, and a 365 hp Heine Straight Tube type.

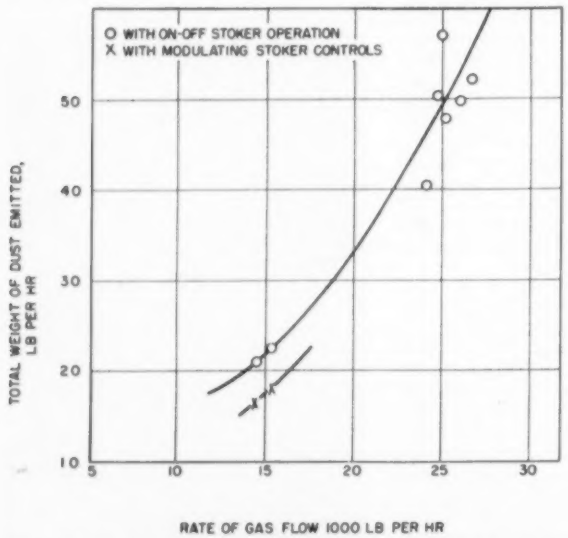
O WITH ON-OFF STOKER OPERATION
X WITH MODULATING STOKER CONTROLS
TOTAL WEIGHT OF DUST EMITTED, LB PER HR
RATE OF GAS FLOW 1000 LB PER HR

Fig. 3. The effect of gas flow and type of stoker operation on dust emission

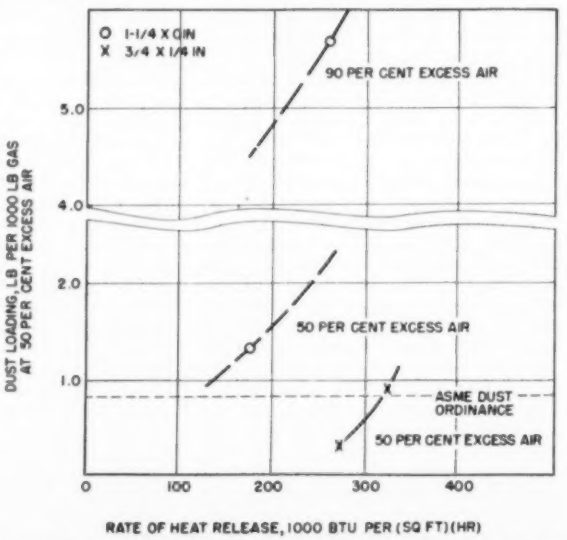
O 1-1/4 X 0 IN
X 3/4 X 1/4 IN
90 PER CENT EXCESS AIR
50 PER CENT EXCESS AIR
ASME DUST ORDINANCE
50 PER CENT EXCESS AIR
DUST LOADING, LB PER 1000 LB GAS AT 50 PER CENT EXCESS AIR
RATE OF HEAT RELEASE, 1000 BTU PER (SQ FT) (HR)

Fig. 4. Shows the effect of coal size and excess air on boiler dust emission

WILL THIS

ORGANIC AGENT ELIMINATE BOILER SCALE AND SLUDGE?

It might.

In water conditioning, the supplementary use of organic agents may well assure the difference between long, uninterrupted operation and frequent boiler outages due to scale and sludge formations.

But a word of warning! Not all organics are the same or equally effective.

Take, for example, the case of a large mid-western steel plant which had to acid-clean its 450 psi boilers at 8-12 month intervals.

Due to sharp variations in the raw polluted river water, the hardness and silica content of the lime soda effluent could not be maintained consistently as low as desired. Despite the use of phosphate-tannin treatment, boilers opened up in poor condition.

Betz Engineers studied the problem and recommended changing the type of organic. Results? Since this change, the boilers have not been acid-cleaned or turbined in three years.

What's more, the latest inspection report after 11 months' operation, showed that the only deposit found in the boilers was a handful of sludge.

If *your* plant is plagued by scale and sludge deposits, why not do something about it *now*, by calling in a Betz Engineer. He'll show you factual evidence how Betz *Specialized* Water Conditioning Service can help you solve *your* water problem. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

Write today for a copy of Betz Technical Paper No. 98, "Boiler Scale —Its Formation and Prevention."

BETZ

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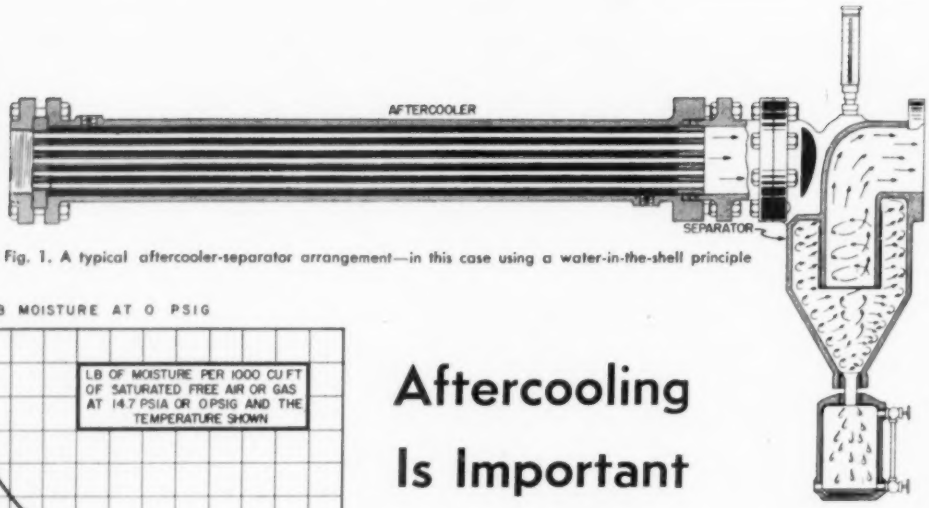


Fig. 1. A typical aftercooler-separator arrangement—in this case using a water-in-the-shell principle

Aftercooling Is Important

By R. A. SCHAEFER Export Dept., Worthington Corp.

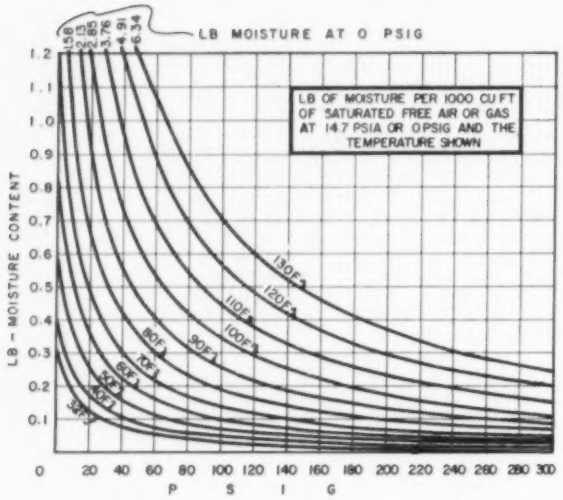


Fig. 2. Chart shows the relationship between moisture content of free air and final pressure and temperature

THE AFTERCOOLER exists in a compressor plant for two reasons: removal of moisture from the air and reduction of discharge air temperature.

Of the two, removal of moisture from the air prior to its entering the distribution system is probably the most important. A wet system, regardless of end use of the air, is not conducive to economical or efficient plant operation, and should not be condoned.

In a foundry, for example, where compressed air is frequently used to dry and dust molds, absence of moisture from air is a requisite. Molding sand, with its closely controlled moisture content, must have sufficient porosity to permit escape of gases generated by hot metal being poured. A dry sand mold, for instance, could be seriously damaged by the molder attempting to air-dust it with a water-laden system. Altered permeability of the sand may cause blowholes to form that will render the casting unfit.

In many cases, the blowhole is not discovered until the machining operation is well under way, and time consumed in the machine shop as well as cost of the casting must be written off as a total loss.

Pneumatic Tools

Maintenance cost of pneumatic tools is also materially affected by moisture in the lines feeding the tools. Lubrication is destroyed through dilution of the oil, and rusting begins when the tool is unknowingly allowed to lie idle with water still inside. Abrasive action of the oxidized matter, together with decreased lubricating value, serve to rapidly shorten tool life. Usually not counted in dollars, but a monetary loss just the same, is loss of productivity entailed by this prematurely aged tool being taken out of service.

Idle time and loss of productivity of operators and machines due to system blowdowns can also run into commanding figures. In a great many of today's modern plants, operators still find it necessary to clear air lines of accumulated water every morning.

Supposing one machine operator takes 3 min each day to clear his air line. After 300 working days the plant will have been denied his services for 15 hr. Chances are his machine will also have been inoperative during this period, so that lost time is doubled.

This period of inactivity doesn't sound earthshaking, but multiply that 30 hr by the number of machine operators in your plant, and you may get a different perspective on cost of a wet system.

In power generating stations too, where air is used to operate delicate boiler feed instruments, the feed cycle can be dangerously impaired by fouling of controls with moisture and foreign matter carried into the system. In any case, moisture removal equipment must be given more than a passing thought if maximum plant efficiency is to be realized.

There are many methods of facilitating this air-drying process, such as sloping of pipes toward drain traps, installation of separators and drop legs at critical points; inserting of tool outlets on topmost sides of the distribution lines. The aftercooler, however, accounts for greatest percentage of moisture removal.

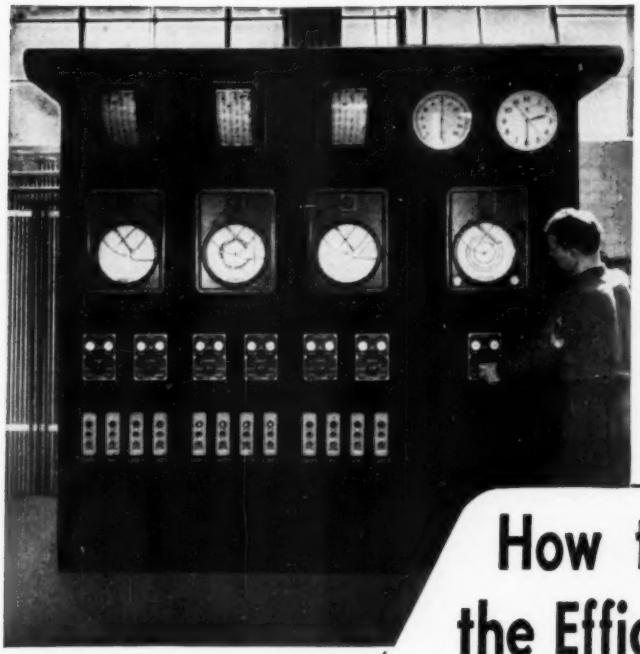
As an example, assume that 1000 cu ft of saturated air at atmospheric pressure and 80 F is to be compressed to 100 psi. As shown by the chart in Fig. 1, this air initially contains 1.58 lb of moisture at prevailing intake conditions. If air is compressed and then cooled to starting temperature of 80 F, the moisture content will then have been reduced to 0.195 lb. Difference is removed from air stream by a separator mounted on downstream side of aftercooler.

A typical aftercooler-separator arrangement is shown in Fig. 1. This particular type employs a water-in-the-shell principle with air passing through the tubes. Cooled air is channelled into separator, where whirling motion induced by baffling causes moisture to be separated and deposited in drain chamber.

Types of Aftercoolers

Aftercoolers can be obtained in a variety of shapes and sizes to meet a particular space condition, ranging from the box-like coil and tank arrangement to vertically and horizontally installed tube-nest types. Whatever your station layout, it's a sure-fire bet that an aftercooler can be fitted into it with little or no revision of the present floor plan.

In some plants, aftercooler usage is bypassed by reasoning that air can be allowed to cool naturally in receivers and distribution lines. In effect this is quite correct; however, this is fallacious thinking from a standpoint of efficiency.



These Bailey Boiler Controls at the Chicago Pneumatic Tool Company's new plant in Utica, N. Y. insure efficient operation of three 25,000 lb per hour, 100 psi, spreader stoker-fired boilers

How to INCREASE the Efficiency of YOUR BOILER-ROOM DOLLAR

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1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

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LIQUID LEVEL · FEED PUMPS

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How They're Improving Bunker C for Gas Turbines

MANY ENGINEERS burning oil under their boilers during the past few years know that the Bunker C oil they have been getting contains certain constituents that have caused corrosion and deposits when burned. Various methods have been used to combat these troubles; in spite of them, oil burning plants want to continue to burn Bunker C because, even with higher boiler maintenance costs, it still may make the cheapest steam. And it usually is very convenient to handle.

In the first work with gas turbines, oil was the usual fuel. However, the problem of slagging and corrosion when burning residual oil soon cropped up in the very earliest work in this country with the gas turbine. General Electric Co. started testing a Bunker C burning gas turbine late in 1947. Since that time, approximately 30,000 hours of Bunker C operation have been accumulated. This operating experience has shown that a basic corrosion problem exists when burning residual oil because slag forming substances present very likely will corrode the metallic parts. A great deal of progress has been made on the solution of this problem, as indicated below, and the work is continuing.

First plant to operate on Bunker C was designed for locomotive use. After test operation at the factory at Schenectady and on the test track at Erie, some corrosion was found in the first stage turbine nozzles. These later were replaced by 25-chrome 20-nickel alloy and some modifications were made in the combustion chambers to reduce operating temperatures. This locomotive power plant subsequently was operated on the Union Pacific railroad for total operating time of approximately 5700 hours. During this time, four first-stage turbine nozzles were ruined by corrosion, apparently from the fuel oil ash.

Shortly after the demonstrator locomotive first was run on a railroad, a 3500-kv power generating gas turbine, using the locomotive design, was installed in the Farmingdale Plant of Central Maine Power Co. Here, too, corrosion occured in the first-stage nozzles. During operation, a high-vanadium fuel, containing 246 ppm of vanadium, was used. Initially it was thought that sodium sulphate, known to be a constituent of the ash deposit, was not corrosive and various factors led to the belief that vanadium was the principal corroding agent, so efforts were made to obtain fuels low in vanadium.

At the same time, Bangor Hydro-Electric Co. installed a 5000-kw regenerative-type gas-turbine generating unit, which started operation on an oil low in vanadium and containing 26 ppm of sodium. After 340 hours of operation, a number of first-stage partitions were corroded badly and the entire nozzle was replaced.

About the same time, the Central Vermont Public Service Co. at Rutland, Vt., installed a similar 5000-kw regenerative-type turbine also operated on relatively low-vanadium, high-sodium oil, but using a 28-per cent chrome nozzle material. After approximately 500 hours of operation on Bunker C, some of the nozzle partitions were warped considerably but none was corroded seriously. First-stage buckets of a high-cobalt, high-strength alloy, however, had been attacked severely.

This experience and that on the Bangor turbine, together with laboratory tests, indicated that sodium sulphate, as well as vanadium pentoxide, could be highly corrosive and would have to be dealt with.

Following these troubles, both the Bangor and Central Vermont turbines were operated for some time on No. 2 heating oil. Unexpectedly, this oil also caused some oxidation in the Bangor machine. The cause of this finally was traced to flame impingement and the combustors were lengthened and this factor has been

(*Continued on page 110*)

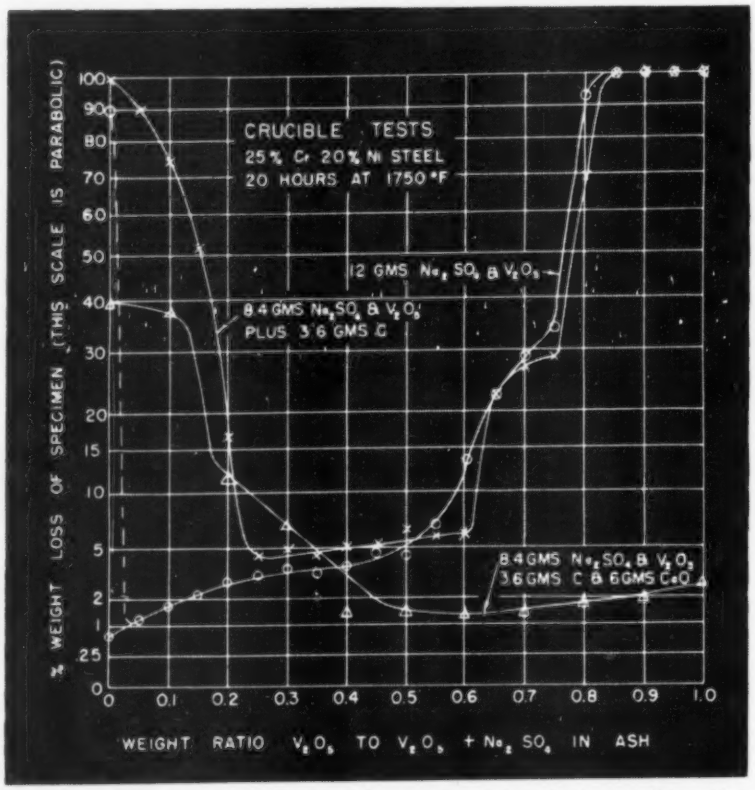
Essential features of specification for Bunker C fuel for gas turbines, proposed in August 1951

1. The ratio of the weight of sodium in the ash to the weight of vanadium in the ash should not be greater than 0.3. This result can be obtained either by removing sodium or by adding an oil with a high-vanadium content or both.
2. a. After condition (1) is fulfilled, the ratio of the weight of calcium to the weight of vanadium in the ash should not be less than 5. Soluble materials can be added to the fuel to obtain this result in case it does not satisfy the condition naturally.

   b. Insoluble material also can be used to obtain the calcium-vanadium weight ratio, except, if used, the minimum calcium-vanadium weight ratio should be increased to 8 and the insoluble material must be finely ground. It should be about 1 micron in size, and it should be used in a manner to ensure that it is dispersed uniformly in the fuel.

   c. Any magnesium, barium, or nickel in the oil is a benefit, and these elements can be substituted for calcium. However, these elements are not as effective as calcium, and two atoms must be substituted of these materials for one atom of calcium.

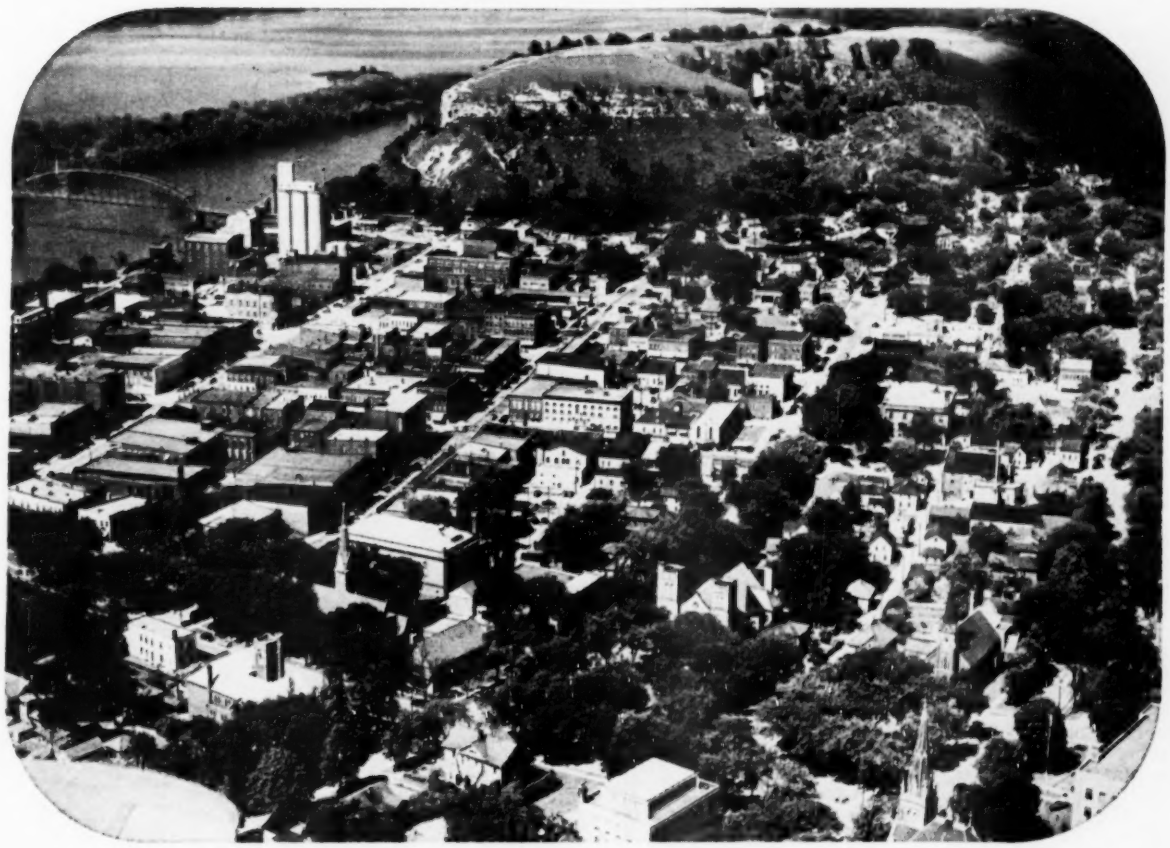
   d. In summary, after condition (1) is satisfied, the following rule should be satisfied: The sum of the calcium atoms and half the barium, nickel, and magnesium atoms all taken together should be six times or greater than the number of atoms of vanadium in the oil.
3. After items 1 and 2 are satisfied, the total ash in the oil should not exceed 0.2 per cent.



Graph showing effects of carbon and calcium additives on corrosion in gas turbine parts due to sodium sulphate and vanadium pentoxide, as shown by crucible tests used in Bunker C laboratory work

RED WING, MINNESOTA
A DETROIT STOKER TOWN

Two Hospitals • The High School • A Hotel
Three Industrial Plants • And the Power Company
All Equipped with Detroit Stokers.



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Red Wing Burns Coal—the Basic Fuel with Detroit Stokers because they are always dependable, economical.

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(*Continued from page 108*)

eliminated. Meanwhile, extensive laboratory corrosion tests were undertaken.

Foregoing experiences with the turbines were described in great detail in a paper before the 1953 American Power Conference by B. O. Buckland and G. M. Gardiner, both of the Gas Turbine Department of General Electric Co. They then described a program of laboratory investigations which resulted in data showing the relationships plotted on the accompanying graph. Results of this investigation and the relationships indicated on the graph are the basis of a fuel specification proposed August 1951, as shown in the table.

More recently, a number of tests also have been made to discover additives that might be effective in reducing sodium-sulphate corrosion. Some 30 different metallic oxides or sulphates have been tried and the paper reports the results obtained with these.

Since January 1952, six gas turbine locomotives have been operating in revenue freight service on the Union Pacific Railroad using Bunker C fuel treated by their oil supplier to satisfy the proposed specifications. These power plants have accumulated a total operating time of approximately 20,000 hours and have burned a total of almost 10,000,000 gal of Bunker C. Although some corrosion still is apparent, the amount compared to that on the demonstrator locomotive is only about 1/10 as much. The laboratory tests are continuing along with the experience in using the specification type residual on the locomotives. Effect of adding oil-soluble compounds, slurries of suspended particles, and emulsions of water solutions with the oil are being tried, although this may be only an interim phase of the oil development.

Work is being done in cooperation with several oil companies to discover ways of producing non-corrosive residual and supplying commercial quantities of such oil to users. It is hoped that Eastern residual oil suppliers soon will be in a position to supply oil suitably modified * when delivered.

It should be noted also that such residual, if available, will be in demand by utilities and industrial plants using oil-fired boilers because these users also have had some corrosion difficulties due to the vanadium compounds in the residual oil. Furthermore, such difficulties are expected to increase with unmodified oil, because of increasing use of modern high-steam-temperature equipment.

* *Editor's Note:* — It also has been reported that some work is being done on centrifuging Bunker C to remove certain of the impurities in it.

Navy Gas Turbines

U. S. Naval Engineering Experiment Station has developed a method to ventilate a closed compartment containing gas turbine engines without ventilation blowers. Tests were made in connection with installation of gas turbine engines for generator drive in a group of wood-hulled vessels now being built for the Navy.

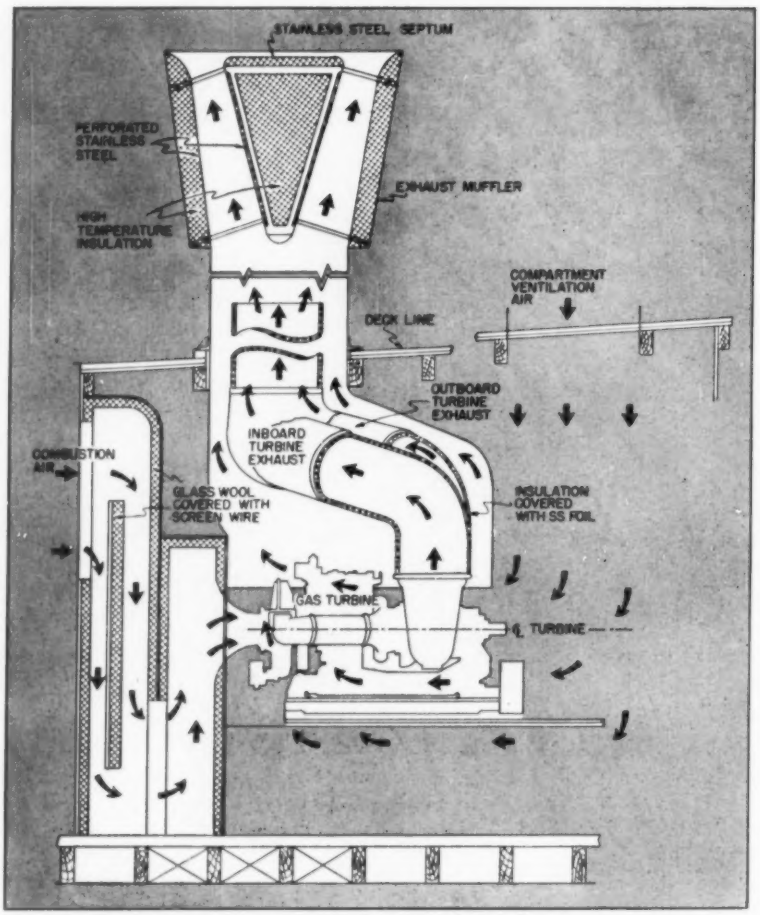
In such wood hulls, the problems are: maintaining satisfactory temperature limit of about 120 F in the turbine compartment and of 200 F in the exhaust duct and stack; providing combustion air inlet system to keep out sea water droplets, partially silence the compressor, and give low pressure loss; providing an exhaust muffler to partially silence the turbine and give low pressure loss.

With the eductor stack system a portion of energy in exhaust gases, otherwise wasted, was put to work ventilating the compartment and cooling the exhaust stack. In the test mock-up, ratio of ventilating air pumped to ambient combustion air was 0.67. This ratio will vary with turbine exhaust velocity, relative stack sizes, ventilation air inlet area, and configurations of inlet air system and inlet to stack annulus. The Navy is now preparing a manual to enable designers to forecast ventilating air flow under particular conditions.

This system also permits decrease in back pressure imposed on turbines. Static pressure measured at the end of the turbine exhaust stack on the mock-up was −1.47 in. of water. Attributing this difference from atmospheric pressure to the eductor, decrease in fuel rate is estimated at 0.6 per cent.

Stack surface temperatures were quite satisfactory. However, where space and weight permits, use of a third stack taking air from the compartment or above deck might eliminate high-temperature insulation around the inner stack.

The Navy now has several experimental gas turbine engine installations in which these designs are being applied.



This diagram shows combustion and air inlet and gas and air exhaust systems, and exhaust muffler

VULcomatic E-4 air-operated rotary head for automatic soot blowing. E-4-E has electric motor drive. Either may be cut into service by push button—or operated in automatic sequence. Cleans effectively. Easily installed and maintained.
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Hand-operated Vulcan P-3 is identical with the VULcomatic E-4 except for drive. In fact, it is quickly converted to an automatic unit by replacing the sheave wheel with an air or electric motor.
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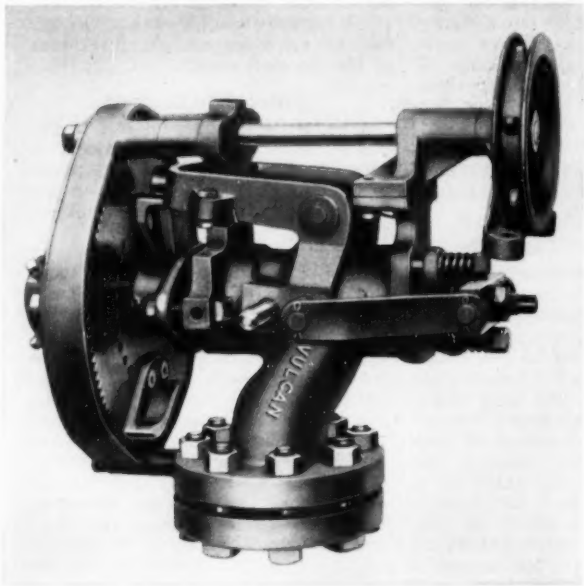

You'll find Vulcan Rotary Soot Blowers doing a thorough cleaning job on many high-duty central station and industrial boilers. Their full-pressure cleaning starts at the crack of a valve, and continues through a complete 360-degree arc. Their valves are protected, for corrosive gases are sealed off. Their installation may be at any angle. And all their parts are easily accessible for inspection or maintenance.

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VULCAN Rotary SOOT BLOWERS

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Broadway Steam Plant

(Continued from page 81)

tures always have caused high heater maintenance. This was the basic reason for going to low-pressure heaters. All heater joints have stainless-steel flexing type gaskets. Soft iron gaskets are inadequate for this service. The bolts were designed in such a way that the temperature changes will be transmitted rapidly to the body of the bolts. Wherever possible welded construction is being used, as in safety valves and steam lines to and from the heaters. In short, every conceivable precaution was taken to minimize the maintenance caused by the rapid temperature changes.

To eliminate the flashing in the drip lines from the heaters during load rejection periods, large subcooling sections are being used on all the heaters. The heater drip depression is 20 F., sufficient to prevent flashing.

Miscellaneous Pumps: — Practically all the smaller pumps used in the plant are vertical, with mechanical seals.

The vertical construction is used to get adequate NPSH (most of the pumps are on ground level). The mechanical seals were specified particularly on the pumps operating below atmosphere to eliminate the necessity of distilled water seals.

Circulating Water

Circulating Pumps: — Two vertical circulating pumps are used to handle the 32,700 gpm required by the condenser under full load conditions. One of these pumps is a 2-speed unit, giving a combination of three possible flows for our wide operating range. Again, since this plant was built at ground elevation, vertical pumps are used so that a pump pit or basement is not required.

A straight volute type of centrifugal pump is used but with the shaft vertical. The entire pump is submerged in an open flume, which connects with the cooling tower reservoir.

To eliminate large and costly valves and sluice gates usually associated with a circulating water system, large streamlined-type check valves only are being used on each circulating pump discharge. No other valves of any description are used on the entire circulating system.

Cooling Tower: — The cooling tower is designed for 8-F approach during the hottest weather experienced in this area. The tower has eight induced draft fans. Top of the cooling tower fan stacks are 55 ft above grade, to reduce fogging on the adjoining freeway to a minimum. Cost of pumping water into a high tower is offset by a decrease in fan power required.

In the past the city has experienced considerable maintenance with the cooling towers due, in part, to the relatively skimpy sections used in the conventional tower. To improve this condition, a much higher design factor was used. Every effort was made to extend the tower life to 20 years without having to replace the structure or the filling.

It has been the opinion of our engineering department that many of the country's power plant engineers have overlooked the design of many of the smaller details in their effort to get the best heat cycles. We feel that more time should be spent on many of these details since they can be a source of high maintenance throughout the life of the plant. One of these details is valves.

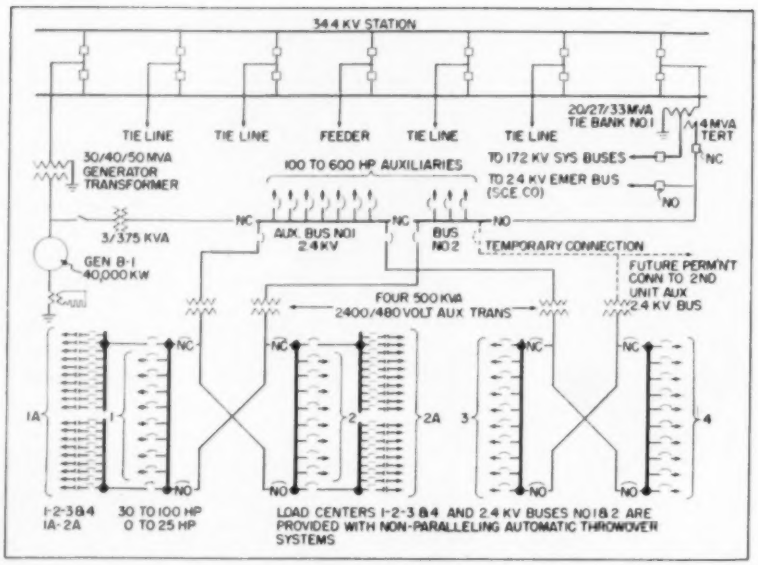


Fig. 4. Single-line electrical diagram for first unit of Broadway Steam Plant, showing auxiliary supply

Valves Selected Carefully

Many plants throughout the country have had severe cases of valve stem pitting. This problem has been a nemesis for most of the valve manufacturers for the past 20 years. Because valves are a highly competitive item, valve quality has been sacrificed. It became apparent several years ago that in a period of two years the valve maintenance exceeded the cost of the valve by a ratio of between 2 to 1 and 3 to 1. In short, we could afford to pay twice as much for a valve that would be maintenance free for an additional year. With this in mind, very rigorous valve specifications were set up for all steel valves, from ½ in to 10 in.

One of the most interesting requirements of these specifications was material. In all cases the valve stems had to have not less than 10 percent nickel. Since steel with 10 percent nickel cannot be hardened, stellite faces were required on bearing surfaces such as the contact area between the stem and the disc. The threads on the stems were not stellited but a special bronze was required and Zerk fittings were provided so that silicone or moly-disulphide grease could be injected periodically.

With very few exceptions, no gate valves are being used on the entire plant; Y-pattern globes are substituted for gates in all the smaller sizes. Pressure seal bonnets or welded bonnets are being used in all services of 150 psi. and above.

Centralized Control

Control: — As pointed out under layout, control of the entire unit is concentrated on one panel. This panel is 43 ft long, extending between the end of the turbine and the front of the boiler.

Most new power plant layouts lean in the direction of concentrating the control in an extremely small area. It is our feeling that if, during an emergency, an operator knows exactly where to go, the few steps required to reach one end of the panel from the other is negligible. We have used concentrated control panels in the past but find that, when an emergency occurs, the operator is confused and seldom gets to the correct knob the first time. However, when the operator knows the exact area on the panel where the trouble can be corrected, he can correct the trouble in a far shorter period of time.

With this in mind we have developed an annunciator system integrated with the control in such a way that an alarm lights up on top of the panel immediately above the area where the trouble can be corrected. To accomplish this, the panel is divided off as to function, both vertically and horizontally. In general, the boiler controls are on the boiler end of the panel, the turbine on the turbine end of the panel, and the auxiliaries in center of panel.

(Continued on page 114)

NO GETTING AROUND IT!

De Laval Oil Purifiers Give Double Protection

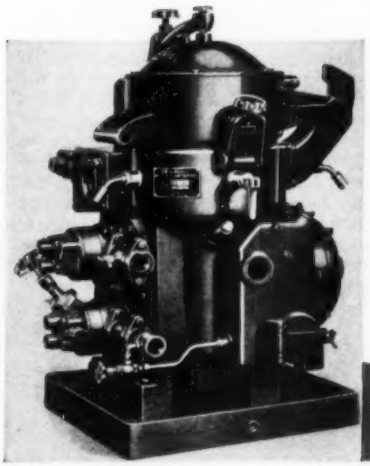
There's no avoiding the fact that a turbine requires protection from ***two*** troublemakers—dirt and water. Any device that removes only the dirt does only half a job.

That is why De Laval Oil Purifiers are so much more effective for maintaining the purity of turbine oil than any other means available. They not only remove solid contaminants but also any moisture that may be present.

It is important to get such ***double protection,*** for oftentimes water, rather than dirt, is the real source of contamination. For example, condensate in oil leads directly to the formation of sludge, and, of course, if a water leak should ever develop, serious emulsification and real trouble might occur.

De Laval Oil Purifiers do not remove oil-soluble additives. The purifying action is entirely mechanical.

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco



DE LAVAL

for more dependable power production

LUBRICATING OIL PURIFIERS

For more data circle 554 on Post Card

How Tight? Drop Tight!

This True Ball Joint Makes the Difference

Spherically ground Dart seats say "no" to leaks as long as in service — and as often as piping is changed. Darts can be taken off the line and used elsewhere time and time again. That's economy! What's more, the tight seal comes easily without heavy wrenching or strain.

QUICK FACTS

- Two bronze seats provide top resistance to pitting and corrosion
- Heavy shoulders can withstand the strongest yanks of the wrench
- Nut and body of air-refined, high test malleable iron are practically indestructible
- Threads are full and clean-cut of hard metal to prevent stripping

Experience proves that the men who *buy* Darts, the men who *use* Darts and the men who *sell* Darts have "something special"!

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston•New York•Pittsburgh•Rome, Ga.

DART
UNIONS

For more data circle 555 on Post Card

(Continued from page 112)

Starting at the top of the panel and going down, the operations are: Alarm, Indication, Recording, Control — Mechanical, Control — Electrical. Vertically the panel is divided off so that, for example, all the above mentioned functions for the feed pump are one below the other.

In like manner, everything pertaining to fuel oil, such as tracer steam, primary pumps, fuel oil heaters, oil flow — air flow meters, are all one below the other.

If trouble should develop anywhere in the entire fuel oil system, anywhere between the fuel oil storage tank and the boiler furnace, an alarm would light up immediately above the section of the panel containing all of the controls for handling the oil between the above mentioned points. This psychologically and literally controls the operator's efforts in such a way that his entire effort is devoted to ironing out the fuel oil system and he is not hampered by other confusing controls.

The face of the panel is concave, made up of a series of flat sections so that no matter at which section of the panel the operator looks, the instrument is at right angles of his line of vision and approximately the same distance from his eyes.

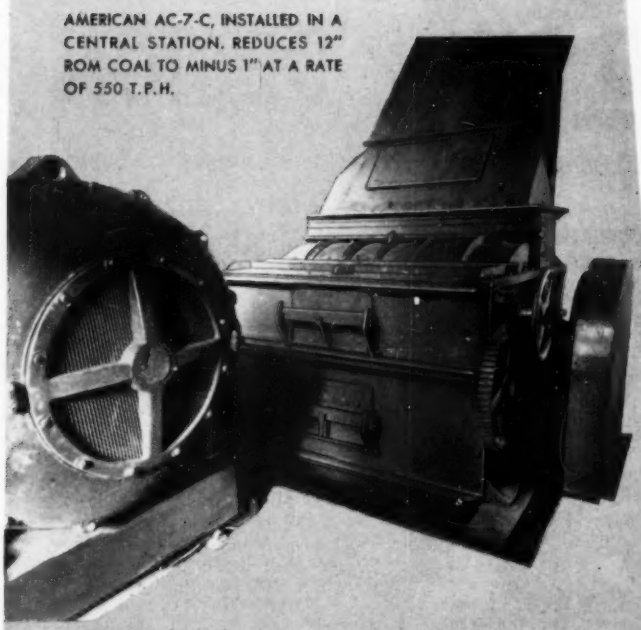
Instrumentation: — The instrumentation for the entire plant is similar to that used in most central stations except that pneumatic transmitters are used between the primary elements and the panel. Consequently no gas, oil, steam or any other fluid at high temperature and pressure enters the control panel area. The miniature line of control knobs and selector valves is being used; however, standard size recorders are installed. This was done because each recorder represents an average of approximately 3 control knobs, which had to be put into approximately the same length of panel as the recording instrument. Space was not the only reason for using the miniature controls. This new line of equipment has several technical advantages.

Automatic Fuel Transfer

A unique and interesting development is being put into practice for the first time with this unit. Normally we burn gas, however, upon notice we are required to change to oil within a relatively short period of time. During this transition period a load swing might fall at the moment when the control was on hand during the switching operation. To eliminate this difficulty a means was worked out, in conjunction with the meter company, whereby either fuel or both fuels can be used without ever having to go on hand control. In short, it is possible to be burning oil and switch to gas without having to go on hand control.

(Continued on page 117)

Check *American* Quality—Feature by Feature—and you'll know



AMERICAN AC-7-C, INSTALLED IN A CENTRAL STATION. REDUCES 12" ROM COAL TO MINUS 1" AT A RATE OF 550 T.P.H.

WHY

AMERICAN CRUSHERS

can reduce coal

for less than

per ton

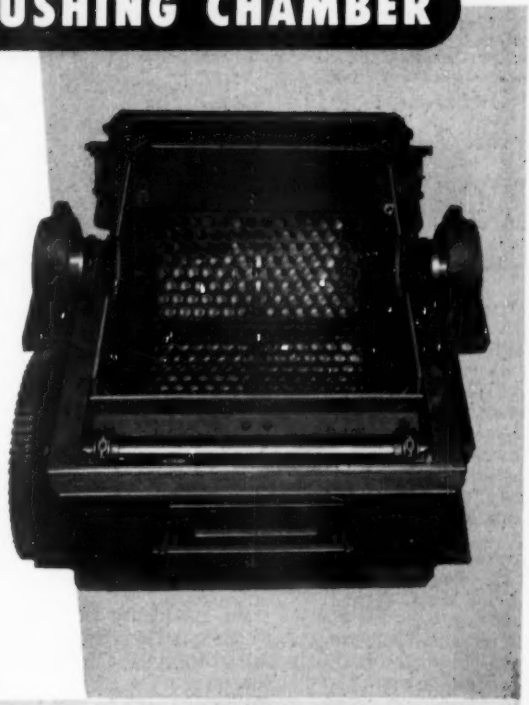
AMERICAN Feature No. 3

COMPLETELY LINED CRUSHING CHAMBER

LOOK INSIDE—before you decide on a crusher. There's the place to check for unstinted quality—the place to look for future performance potential.

Look inside an AMERICAN CRUSHER. There, for example, you'll find the American-designed chamber liner — thick punish-taking plates which completely line the crushing chamber . . . sectional for easy plate-at-a-time replacement . . . engineered to offer *lifetime* protection to the vital frame and housing structures.

This liner, plus the all-manganese steel shredder rings, breaker plate and grinding plate explain why the rugged work area of every American Crusher operates on such low maintenance costs . . . why Americans stay on the job year after year—as top performers!



American

PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1431 MACKLIND AVE. • SAINT LOUIS 10, MO.

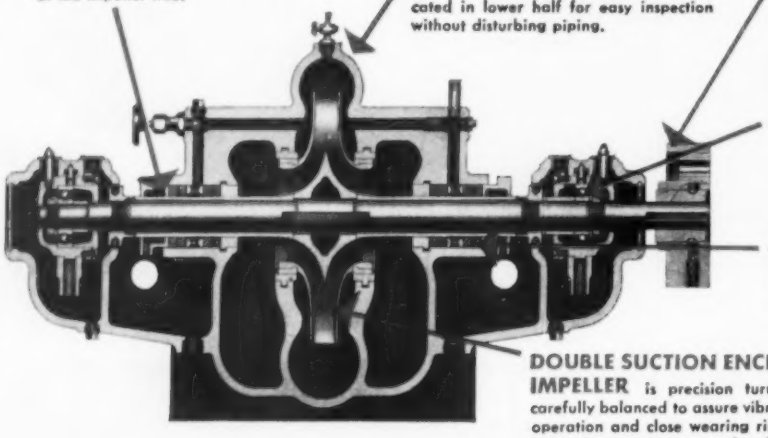
For more data circle 556 on Post Card

Look for These 7 Signs of GOOD PUMP DESIGN

CAST SHAFT SLEEVES, not commercial tubing, save the shaft from wear. Sleeves extend through the stuffing box and seal at the impeller hub.

HEAVY HORIZONTAL SPLIT CAST-IRON CASING construction with suction and discharge nozzles located in lower half for easy inspection without disturbing piping.

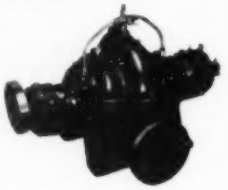
COUPLINGS have *Magic-Grip* quick change bushings for pump and drive shaft. Pin and rubber bushing type usually used. Removal for maintenance is easy.



BALL BEARINGS may be furnished for either oil or grease lubrication. Sleeve bearings also available in larger sizes.

GENEROUS STUFFING BOX LENGTH contains sufficient packing to keep stuffing box maintenance low. Provision is made for sealing water connections or for grease seal if these are required.

DOUBLE SUCTION ENCLOSED IMPELLER is precision turned and carefully balanced to assure vibrationless operation and close wearing ring clearance. Water passages are hand finished to a smooth surface.



STANDARD AND SPECIAL MATERIALS are available for many types of service where government regulations permit. Iron, bronze, stainless steel and combinations of these materials handle both alkaline and acid solutions. Standard sizes carried in stock range from 10 to 7000 gpm with heads as high as 475 feet.

ALLIS-CHALMERS Double Suction PUMPS

THESE DESIGN AND CONSTRUCTION features of Allis-Chalmers double suction pumps assure long pump life and low maintenance costs. Every A-C double suction pump is carefully tested on the most modern pump testing equipment in the industry.

Complete Pumping Unit

Allis-Chalmers can furnish the complete pumping unit — pump, motor, control and drive — all of coordinated design and manufacture.

Whatever your pumping problem, call your nearby Allis-Chalmers Authorized Distributor or District Office. Or write for Bulletin 08B6146. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3952

Texrope, Magic-Grip, and Vari-Pitch are Allis-Chalmers trademarks.

ALLIS-CHALMERS A-C

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Distributors, Certified Service Shops and Sales Offices throughout the country.

MOTORS — ½ to 25,000 hp and up. All types.

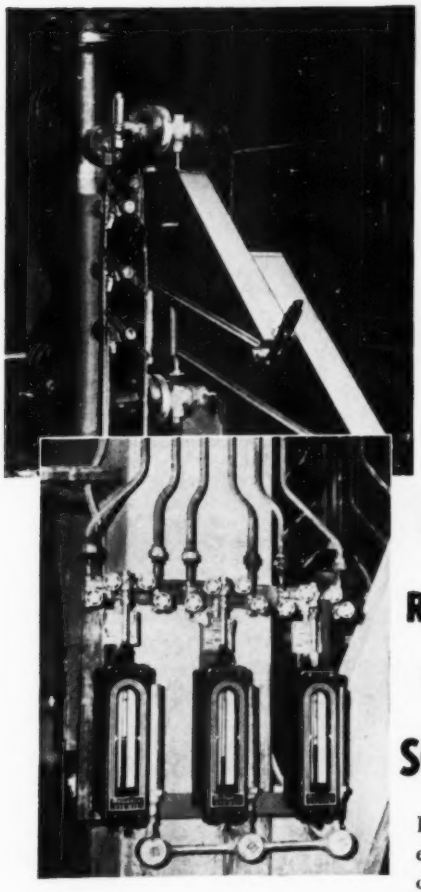
CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE V-belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

For more data circle 557 on Post Card

IT TAKES *Double Supervision*

to assure full safety from water level failure



Reliance Safety Team warns operators by SOUND and by SIGHT

Prevent boiler outage and expensive water level accidents. Have double safety through *double supervision* — so easy to obtain with the Reliance Safety Team. The automatic alarm water column has saved thousands of boilers from damage or explosion. Its sensitive mechanism sounds a shrill whistle or other *sound* warning the moment dangerous water levels develop.

Most operators don't want to hear that final warning so they keep tab on the gage reading. The handiest, easiest gage to read is the *eye-level* gage — the always accurate Reliance EYE-HYE Remote Reading Gage. Mount it on instrument panel or wall. Its illuminated green indicator is hard to miss.

Ask your nearest Reliance Representative about the Safety Team, or write to the factory.

THE RELIANCE GAUGE COLUMN CO., 5902 Carnegie Ave., Cleve. 3, Ohio

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

For more data circle 558 on Post Card

(Continued from page 114)

To eliminate the undesirable features of a dry air compressor (non-lubricated carbon piston), three heavy-duty horizontal lubricated compressors were used, each pumping into a common header. The operator can select any one of the three to be the preferred machine. Upon a reduction in header pressure the second machine will automatically start. If the pressure continues to drop, the third will automatically start. This header is connected to the service air piping through an automatic shut off valve which, upon loss of header pressure with all three compressors on, will automatically close.

Instrument air is taken from the same service air header and piped to two bauxite-filled oil filters, then to a pair of silica gel Driers, than to a combined mechanical separator and cloth filled filter, and finally into the pressure reducing stations and instrument manifold system. All instrument air piping is brass or copper. The shut-off valve previously mentioned, between the air header and the service air piping, is installed so that if somebody should overtax the service air system and jeopardize the instrument air supply, the service air will shut off automatically and all the air be diverted to the instruments.

Electrical Features

The electrical system for handling the plant auxiliaries is of the non-paralleling selective type with automatic throwover. The normal source of current is the auxiliary transformer tied directly to the main generator bus.

The auxiliary electrical system is divided into two parts in such a way that one-half load can be carried on the unit with one section out. Automatic throwover is provided, which ties in to the substation for a source of starting current and for emergency use.

All electric motors for the auxiliaries are totally-enclosed, fan-cooled, with the exception of the boiler feed pumps. These are totally-enclosed, water-cooled motors. Use of totally-enclosed motors throughout is more than justified on the basis of decreased maintenance; totally outdoor construction; elimination of motor heaters; and, in the case of the three boiler feed pump water-cooled motors, elimination of noise.

On the hand-control switches, an interesting feature is the use of a selector switch, one for each set of motors so arranged that the operator may select the preferred machine or he can run all of the drives for any one service, but he cannot stop all motors on any one service except by pulling the handle towards him and to one side. In this way we have eliminated the chance of inadvertently dumping any one of the auxiliary systems.

From Head to Hose

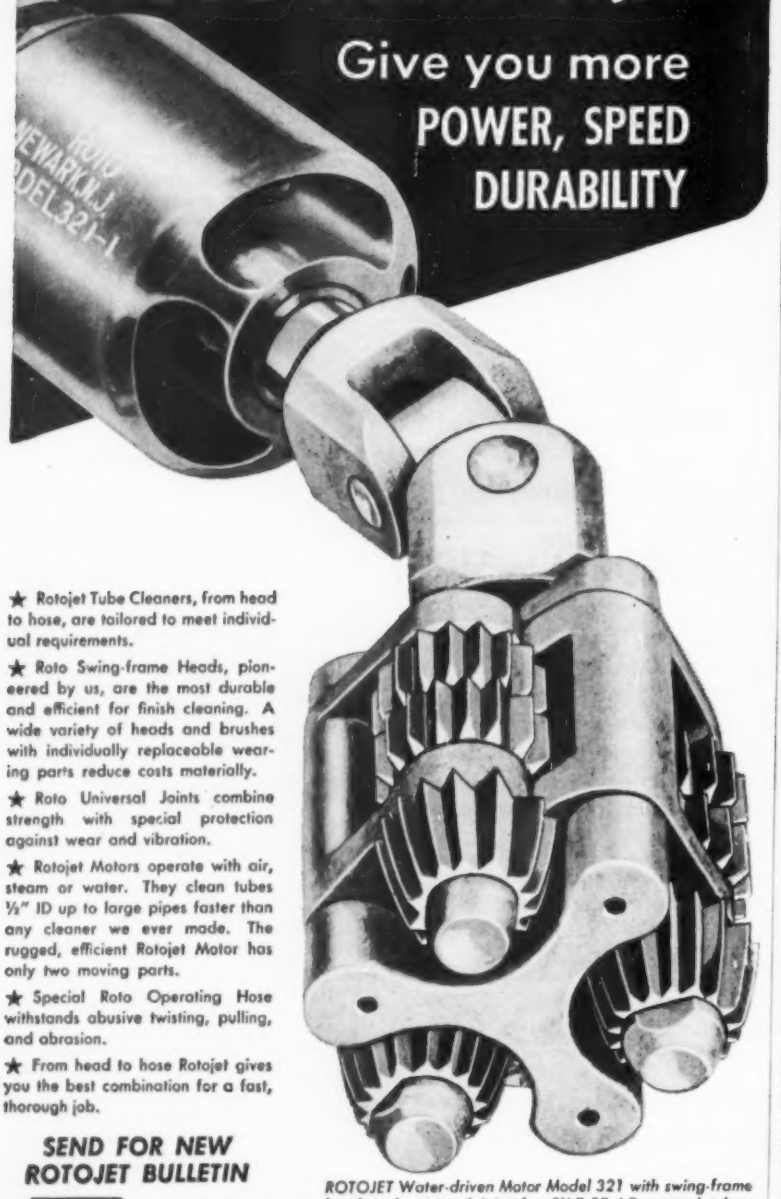
ROTOJET®

TUBE CLEANERS

Give you more

POWER, SPEED

DURABILITY



★ Rotojet Tube Cleaners, from head to hose, are tailored to meet individual requirements.

★ Roto Swing-frame Heads, pioneered by us, are the most durable and efficient for finish cleaning. A wide variety of heads and brushes with individually replaceable wearing parts reduce costs materially.

★ Roto Universal Joints combine strength with special protection against wear and vibration.

★ Rotojet Motors operate with air, steam or water. They clean tubes ½" ID up to large pipes faster than any cleaner we ever made. The rugged, efficient Rotojet Motor has only two moving parts.

★ Special Roto Operating Hose withstands abusive twisting, pulling, and abrasion.

★ From head to hose Rotojet gives you the best combination for a fast, thorough job.

SEND FOR NEW ROTOJET BULLETIN

ROTOJET Water-driven Motor Model 321 with swing-frame head and universal joint for 2½"-3" I.D. curved tubes.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue Newark 1, N. J.

For more data circle 559 on Post Card

Air Conditioning

(*Continued from page 97*)

halls and through return air registers in doors leading to the hall. In the room (or plenum), the return and outside air mingled and passed into the air cooling unit.

There is nothing wrong with this set-up, in fact, it is quite a common practice; but suppose we examine the layout and see what was left out by the contractor. In each outside wall, the entrance for fresh air was a hole about 16 in. by 24 in. provided with crude wood louvres to keep out rain. The area of this opening remained constant the year round. Whatever the load conditions might be for each season, or however low the temperature dropped in winter, there was that hole in the wall without even a hand damper to control the amount of outside air pulled into the system by the fan.

During much of the heating season, the water heating coils were overloaded and a comfortable temperature was impossible. In summer the cooling coils were overloaded by having to remove the excess moisture. A modulated damper installation immediately corrected this condition and there was a consequent reduction in fuel bills.

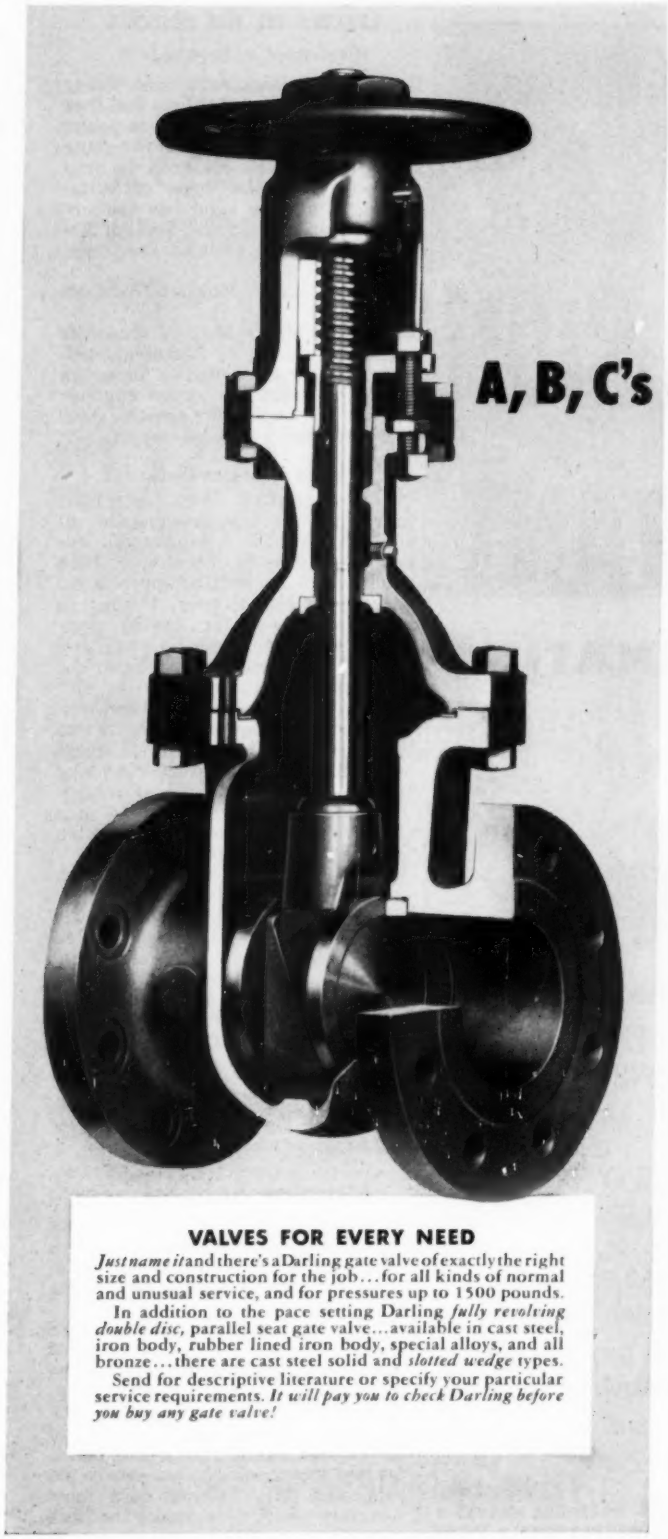
Turbine Generators

(*Continued from page 100*)

cooling was being considered for generators and also that all three of the large generator manufacturers had come to see that their large turbine generators can be made much smaller, or that much higher ratings are obtainable with the same overall dimensions. However, he concluded, standing as a lone wolf on the side lines, as he regarded recent developments, he was amazed to contemplate to what extremities they had gone. "In general," said Mr. Fechheimer, "the manufacturers' engineers engaged in this work are to be commended for their courage, although I disagree with their proposed methods."[1]

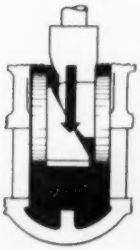
Whatever the respective merits of the various proposed or actually built systems of cooling may be or whatever system or combination of cooling systems may ultimately be adopted, there is little question that the attention this branch of electrical engineering is receiving will lead to the production of still larger and better turbine generating units. Progress is being made on many fronts — in magnetics, in dielectrics, in mechanical construction, and, now, in new methods of cooling. Only a year or two ago, the maximum size bushings for generators were rated around 6000 amperes. Now, as indicated by Mr. Kilbourne, manufacturers are planning to design single bushings for currents as high as 11,000 amperes.

[1] The liquid cooling scheme proposed by Mr. Fechheimer involved the use of passages through the rotor core itself. Water, or other liquid coolant, was forced through these ducts by centrifugal pump action of the rotor itself.



DARLING VALVES

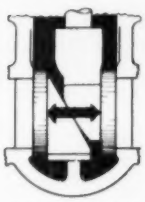
A, B, C's of better valve service with DARLING Revolving Disc GATE VALVES



GATE DESCENDING

A EXTRA LIFE

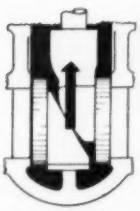
Fully revolving discs, independently hung, change seating position at each closing, assuring uniform wear distribution for prolonged service. Plain "no pocket" discs are interchangeable for *extra* life!



GATE CLOSED

B POSITIVE CLOSING

Faces of the upper wedge are radiused and faces of both wedges are transversely beveled for equalized wedging pressures and tight closing despite valve body distortion.



GATE RISING

C EASIER OPERATION

Wedging pressure on both discs is released before discs start to rise. Complete absence of wedging pressure during travel of discs assures easy operation and greatly prolonged valve life!

VALVES FOR EVERY NEED

Just name it and there's a Darling gate valve of exactly the right size and construction for the job... for all kinds of normal and unusual service, and for pressures up to 1500 pounds.

In addition to the pace setting Darling *fully revolving double disc*, parallel seat gate valve... available in cast steel, iron body, rubber lined iron body, special alloys, and all bronze... there are cast steel solid and *slotted wedge* types.

Send for descriptive literature or specify your particular service requirements. *It will pay you to check Darling before you buy any gate valve!*

DARLING VALVE & MANUFACTURING CO.

Williamsport 19, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

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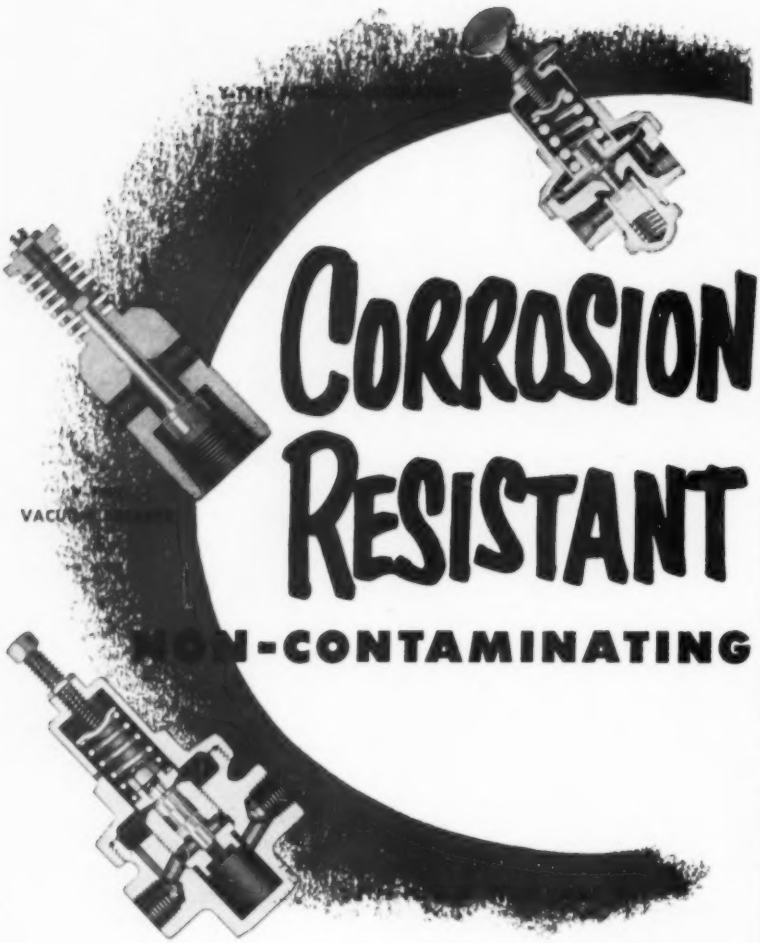

Foster Reducing Valves, Relief Valves, Vacuum Breakers and Liquid Level Valves are available in all-stainless construction to resist corrosion and avoid contamination.

All valve parts in contact with fluids may be had in a wide range of corrosion resisting alloys.

For corrosion resistant, non-contaminating service, plus the usual Foster dependability and maintenance-free performance, it will pay you to tell your Foster Representative your requirements.

PRESSURE REGULATORS • RELIEF AND BACK PRESSURE VALVES • CUSHION CHECK VALVES • FAN ENGINE REGULATORS • PUMP GOVERNORS • TEMPERATURE REGULATORS • FLOAT AND LEVER BALANCED VALVES • NON-RETURN VALVES • VACUUM REGULATORS OR BREAKERS • STRAINERS • SIRENS • SAFETY VALVES • FLOW TUBES

FOSTER ENGINEERING COMPANY • UNION, N. J.

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LETTERS TO THE EDITORS

(*Continued from page 101*)

liquid extinguisher is the most widely used for Class B and C fires and that to ignore it in such a report to power engineers is a disservice to the cause of fire protection. We hold no brief for any particular type of extinguisher, but this type has too important a place in the field of fire protection to be omitted from consideration.

New York — ROBERT NATHANS

Editor's Note: — Mr. Nathans is director of the Safety Research Institute, Inc. He is preparing for us an article on what the power engineer needs to know about fire extinguishers. That will clarify the whole matter.

No Reheat Line There!

MY ATTENTION has just been called to your acknowledgement of your plant visit to Acme Station, appearing on page 71 of the April, 1953 issue, which we greatly appreciate.

After reading it over, I want to apologize to you for having done such a poor job in describing our long steam turbine lines to you. You refer to a steam line and a *reheat* line, and that's where I apparently misled you. The fact of the matter is there are two lines all right, but both are main steam lines, running from the boiler to the turbine and *without* reheat. Two lines were chosen instead of a single line because of manufacturing facilities and line flexibility.

Toledo, Ohio — D. J. ROUX

Editor's Note: — No, Mr. Roux did not do a poor job in describing his steam lines. He is assistant plant superintendent of Acme Station of the Toledo Edison Co. and knows every detail thoroughly. Without any question he described the lines right. But our editor was so used to seeing reheat on new units like this that he jumped to a wrong conclusion from his notes. This is a really serious technical error and he hangs his head.

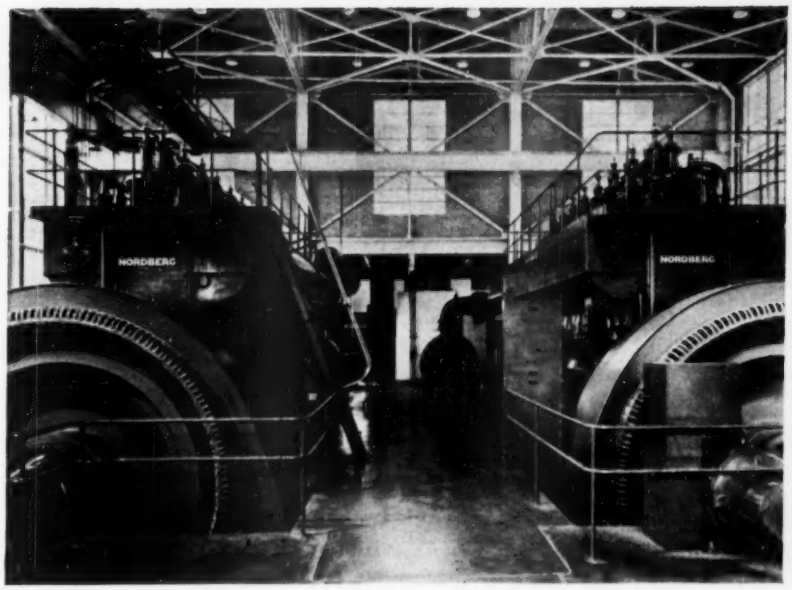
More on Suggestions

IN THE JUNE issue, page 69, you publish some comments by Ambitious Al, in which he questions my statements on suggestion systems in the May issue.

Al's comments are exactly in point of one of the situations I commented upon: i.e., a bland overlooking of the point brought out in the suggestion. He does exactly what is expected from so many award boards. His citing of the Fellows award is not a good point, for it is the exception that proves the rule, and Mr. Fellows' idea most certainly would come under the head of major invention.

Another point I would like to clarify. In no way did my article ridicule or demean minor inventions. But I have seen too many minor awards; whereas, if the matter had been considered thoroughly, many

W. T. Elliott,
Power Plant Supt.,
says...



"We've Got Facts to Prove Rubilene's Superiority"

A lot of people depend on Mr. W. T. Elliott. For it's his job as Power Plant Supt. to see that the City of Denton, Texas has unfailing light and power 24 hours a day. To help live up to that responsibility, Mr. Elliott pampers his hard working Nordberg Duafuel® engines — makes sure they're lubricated with the finest oil available. He says, "We've been using Sinclair RUBILENE® since 1948 with *very satisfactory results*. Cylinder liner wear is only ⅓ of 0.001 inch per 1,000 hours running. Piston ring life is 16,000 hours of operation and we get 6,100 H.P. hours per gallon of oil... Facts like those have definitely sold me on RUBILENE."

Why not let the facts prove to you, too, RUBILENE is a superior lubricating oil. Phone your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save wear and replacements

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It will pay you to look into Bird-Archer's 8 Point Water Treatment Service.

1 PLANT SURVEY—Complete studies of your use of water or steam including equipment and past performance.

2 STUDY OF ALL AVAILABLE WATER—Exhaustive analysis of water supplies starting at source.

3 LABORATORY SERVICE FOR SCIENTIFIC ANALYSES—Modern laboratory facilities with seasoned chemists specializing in water analyses and research.

8 ENGINEERING SERVICES FOR WATER TREATMENT

For Power • For Process • For Cooling

BIRD-ARCHER
WATER TREATMENT
THE BIRD-ARCHER COMPANY,
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FOR COUNSEL BACKED BY OVER SIXTY YEARS OF EXPERIENCE CALL BIRD-ARCHER'S QUALIFIED WATER TREATMENT ENGINEERS. CONSCIENTIOUS, PERSONAL ATTENTION AND HIGHEST QUALITY CHEMICALS.

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major changes would have been made.

And another point: — In writing the article, I overlooked no economical, psychological or other factor that would be appropriate. Covering a general territory in such a manner was the product of a great deal of thought, yes, and experience.

As for employees not knowing what it is all about, that is so much poppycock. There is plenty that management does not know, as it will readily admit; or, if not readily, will do so when it is observed that the huge research facilities are not maintained for the pleasure of it. Al, throw away your Pollyanna complex and take a look at the facts!

Stillwater, N. Y. WILLIAM SHEFFER

Old Engines

THAT LETTER on page 57 of the May 1953 issue, from H. B. Reynolds, was of much interest.

Mr. Reynolds I never knew personally, but as a mechanical engineer he was well known and grew up under the late H. G. Stott, the guiding genius of the original New York City Subway System, especially the mechanical features of its power stations.

Personally I think Mr. Reynolds' appeal might be a call for the Ford Museum.

The rest of the story, of course, includes the electrical features. The generators were originally rated 5000 kw but actually could carry 7500 kw. And in addition, a vertical exhaust turbine was added, capacity 7500 kw, with an induction generator. So the ultimate unit, main and exhaust, developed three times the original rating.

Another interesting related recollection is of an AIEE meeting where both the late M. I. Pupin and Harold Pender spoke of the limited application of the induction type generator. Then Dr. Steinmetz, in his high-pitched voice, said in substance: "Do you not know, Dr. Pupin and Dr. Pender, that within a mile of this auditorium there is now installed and operating the highest capacity of the induction-type generator in the world."

These combination units were in operation until a few years ago and one or two are still there. When the main reciprocating unit starts up, the vertical turbine generator starts up automatically when the exhaust steam flows through it. Just who originated the idea I never knew.

C. O. VON DANNENBERG

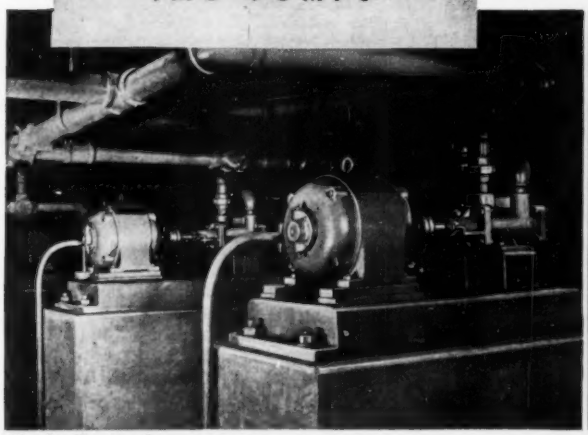
Brooklyn, N. Y.

Emergency Power Vital

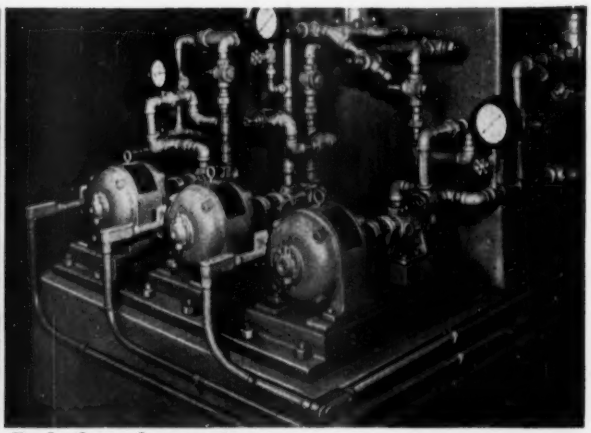
IN H. D. FISHER'S "Economical Ways to Modernize Small Industrial Power Plants," page 71, June 1953 issue, Fig. 4 innocuously points to one of the critical items of the isolated industrial power plant — an emergency generator set.

DE LAVAL
IMO PUMPS

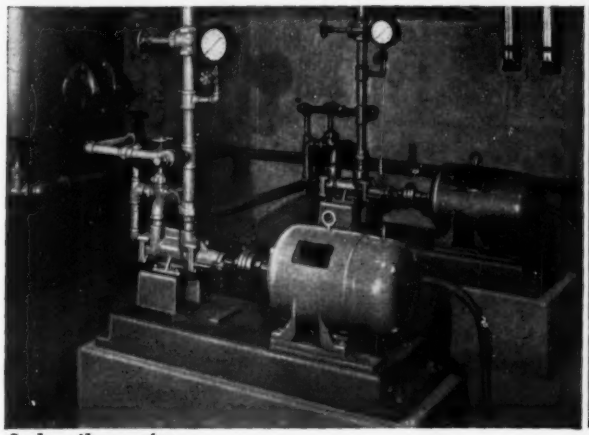
hold down 4 jobs at Owl's Head



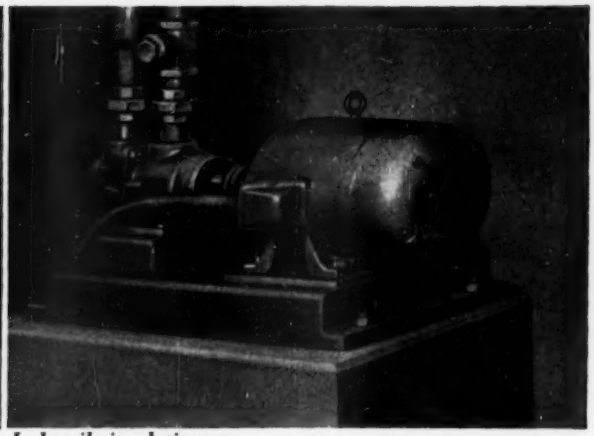
Fuel oil transfer



Fuel oil supply to engines



Lube oil transfer



Lube oil circulating

Again De Laval IMO rotary pumps prove their versatility. Eighteen of them are handling all the fuel and lube oil services for the six National Supply Company dual-fuel engines in the new Owl's Head sewage treatment plant in Brooklyn, New York.

The unique IMO design—*with only three moving parts*—assures long, trouble-free performance. IMO pumps are quiet, pulsation-free, compact and excellent for direct-connected high-speed operation.

Whether your power source is dual-fuel, gas or diesel engine, or oil-fired steam, be sure to specify IMO pumps for your next oil handling job. Use them in high and low pressure fuel oil burner sets, pumping fuel oil to burners, unloading and transferring fuel and diesel oil, handling oil for lighting off service and providing pressure lubrication on pumps and turbines. Send for Bulletin LG showing complete IMO line for capacities to 1,000 gpm at pressures to 500 psi and for capacities to 150 gpm at pressures to 1,500 psi.

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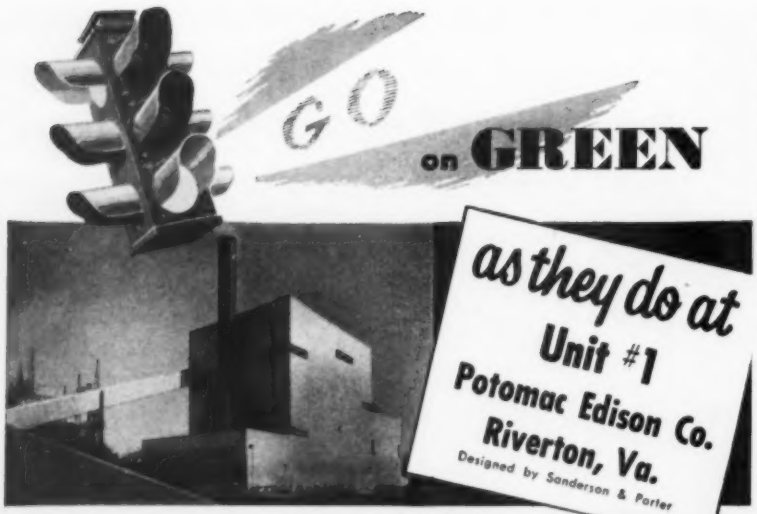
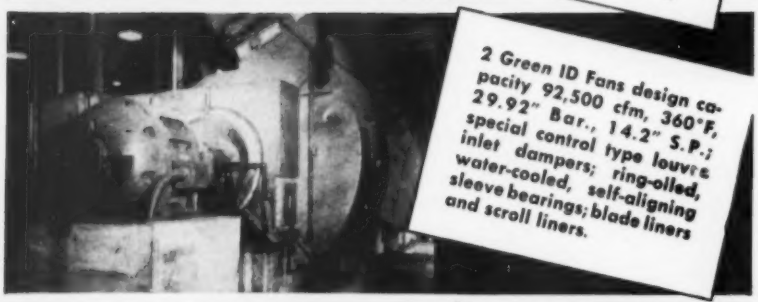
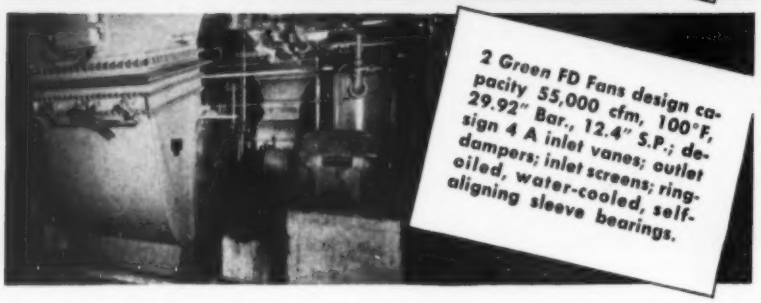



2 Green ID Fans design capacity 92,500 cfm, 360°F, 29.92" Bar., 14.2" S.P.; special control type louvre inlet dampers; ring-oiled, water-cooled, self-aligning sleeve bearings; blade liners and scroll liners.


2 Green FD Fans design capacity 55,000 cfm, 100°F, 29.92" Bar., 12.4" S.P.; design 4 A inlet vanes; outlet dampers; inlet screens; ring-oiled, water-cooled, self-aligning sleeve bearings.

The list grows—the list of utility and industrial steam generating plants for which Green Fans were selected to provide the air necessary for combustion purposes.

Draft fans yield to no other equipment in their importance to efficient steaming. They must be properly designed for the requirements in each plant respectively. They must be conservatively rated. And they must be durably constructed.

Green Fans fulfill these basic requirements. You wouldn't find them in so many large utility plants and large industrial plants unless they had thoroughly proved their worth.

Our Catalog No. 168 tells all about Green Fans. Write for a copy.

THE GREEN Fuel Economizer COMPANY INC.

- Economizers
- Fans
- Air Heaters
- Cinder traps
- Aerodyne Dust Collectors

BEACON 3, NEW YORK

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That picture brings to mind several instances where some similar emergency source of power would have meant a great deal. One steel mill had all of its boiler stokers and fans electrically driven only. A power failure in the generator house stopped the boiler equipment, and steam pressure was lost. Not one boiler had a steam-driven set of auxiliaries to keep a reserve steam supply available. There was no emergency power source available to start the stokers and fans in order to get up steam to run a small generator to supply some electric current. Finally, two steam locomotives from the adjacent railroad were brought into the plant and connected directly to a small Corliss-engine-driven generator. That supplied current to get steam up on the boilers, which then ran the plant turbine generators.

At another isolated industrial power plant that had two large pulverized coal boilers, it was decided, after a number of narrow escapes, from loss of flame in coal firing and resulting steam failures, to install large city gas burners of sufficient capacity to generate enough steam to run the plant's smaller generators, in case of coal or power failure. These gas burners were designed for full firing, to the limit of their natural stack draft, completely independent of electrically driven equipment — fans, pulverizers, and so on.

It was deemed less expensive to use gas firing at city rates, if such an emergency should occur, even with rare probability, than to carry the monthly standby charges for an interconnection with the local power utility. Later expansion of the plant, beyond their requirements for winter exhaust and bled steam, made a permanent electric interconnection with the local utility worth while. Standby charges were erased and isolation problems eliminated.

A third plant had a minor electric failure that shut off all plant power. The results could have been very costly in production losses if steam pressures were lost. The plant might have been down for hours until some drastic means of restoring power had been worked out, if a power interconnection had not been available. All generating auxiliaries for the steam boilers would have been shut off.

Hospitals, telephone exchanges, and other critical plants that cannot stand isolation have their own emergency gasoline-driven or other auxiliary power producers, run by some "infallible" fuel.

That innocuous emergency generator set could be worth its weight in gold if a power and steam failure occurs, where no means of starting up the first components of the boilers have been designed into the plant. Either emergency generators or power interconnections are vital links in the steam power plant of an industrial facility.

Dayton, Ohio R. W. FREDERICK

STANDARD HD
TRADE MARK
OIL

21,000 hours young!

● This 1320-hp diesel engine has provided many hours of economical service for the City of Benson, Minnesota, Water and Light Department since it was installed in October, 1948. It has been operated on an average of 20 hours each day and has generated over 13 million KW at an average load factor of 75%.

In this hard-working diesel, the lubricating performance of STANDARD HD Oil has been outstanding, particularly in view of the fact that crude oil has been used as fuel. Visual evidence of the clean, protective lubrication provided by STANDARD HD is presented in the above unretouched photograph of a piston removed from the diesel after 21,000 hours' operation. Deposits are at a minimum; rings are free. The original fill of STANDARD HD has not been changed, yet a recent examination and analysis of the oil showed it to be in excellent condition.

Diesel operators throughout the Midwest are receiving service like this from STANDARD HD Oil. The Standard Oil lubrication specialist serving in your section of the Midwest will be glad to give you information about the use of STANDARD HD in plants near your own. Just phone your local Standard Oil office. Or, write: Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY STANDARD *(Indiana)*

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You may be doing just that if your plans don't include CHLORINATION EQUIPMENT for slime control by WALLACE & TIERNAN.

Chlorination equipment because it controls slime that *grows* on the walls of condenser tubes not protected against it. Enough of the growth eventually seriously reduces heat transfer efficiency — actually *insulates* your steam from the cooling water. Back pressures go up, production drops, operating and maintenance costs rise, and eventual shut-down becomes necessary for regular clean-out periods.

Wallace & Tiernan equipment because it is versatile, sturdy and dependable — proven by thousands of successful installations, vouched for by satisfied users everywhere-and because there's a Wallace & Tiernan chlorinator for every job. Write today for information on how Wallace & Tiernan chlorination may help you solve *your* slime problem.

NO WATER IS SLIME-FREE

regardless of the source. Chlorination helps reduce slime in make-up or cooling water.

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CHLORINE AND CHEMICAL CONTROL EQUIPMENT
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Converting HP to LP

I CANNOT AGREE with Mr. George H. Hill's statement, in the April POWER ENGINEERING, page 98, that boilers operating at over 100 psi pressure require a greater relieving capacity for safety valves than do boilers operating under 100 psi. The reverse is true. The safety valve capacity is based on the heating surface and type of firing. Pressure is not a factor.

Refer to a capacity table for safety valves. A 3½-in. safety valve of a well-known manufacture has a capacity of 11,400 lb per hr when set at 125 psi. The same valve with proper springs, set at 15 psi, has only about 2750 lb capacity. This is due to the difference in densities at the different pressures. Valves of the same nominal size have widely varying capacities due to lift, resistance to flow, etc. In many cases, by going to a high-capacity valve, the present safety valve nozzles are adequate. However, when this is not true, additional nozzles may be attached to the boiler or on the steam outlet ahead of the stop valve.

The nozzles may be riveted or welded to the shell or drum; however, if there is a possibility that the boiler will ever be used again at pressures over 15 psi, the nozzles should be riveted.

St. Louis, Mo. D. KINCAID

Editor's Note: — In publishing Mr. Hill's comment (Answer No. 504, What Changes Are Needed to Drop Heating Steam from 125 psi to 15 psi) we should have inserted a comment to the effect that his remark about the safety valves was in direct opposition to all the statements about it by others who answered the question.

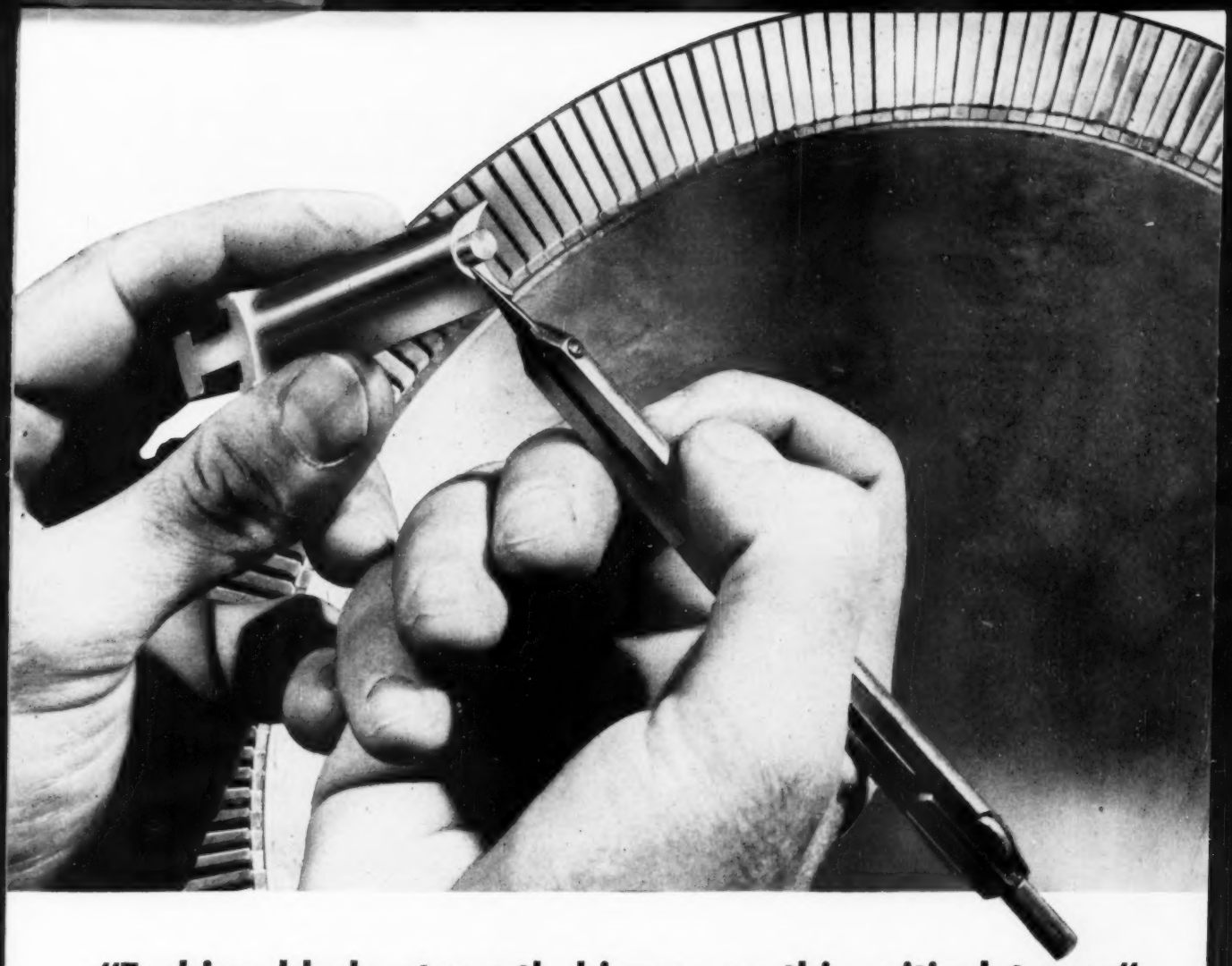
Mr. Kincaid is Supervising Inspector, Boiler Division, Mutual Boiler and Machinery Insurance Co. and presumably is thoroughly familiar with the whole safety valve requirement.

Wood Bearings

They Had 'Em—Automatic Alarms on 'Em

IN THE FEBRUARY issue, the letter by Robert H. Rogers on Wood Bearings brought back a few memories dating back to my early industrial experience in a small manufacturing plant in New England. The Editor's Note mentioned that lignum vitae step bearings were used in New England textile mills many years ago. To my own knowledge such bearings were used several years after that.

In addition to the lignum vitae bearings, we had exactly the same type of gear with maple teeth as shown, by Mr. Rogers. One of the precautions that had to be taken with the wooden gears was to be sure to replace the step bearing before it had worn far enough to lower the wooden teeth away from the cast iron bevel gear, because at a certain point the outer edges of the teeth would strip



"Turbine blade strength hinges on this critical tenon"

Westinghouse research proved that a single rough notch or "square corner" at this critical point reduces blade strength by 50%! All blades vibrate at their natural frequency. The amplitude of the vibrations must be carefully controlled. Any notch or "stress concentration" reduces allowable amplitude—reduces blade strength.

Fifty years ago Westinghouse recognized the importance of vibratory stress considerations, and today has an unequaled wealth of data upon which each new design is built. In these blade tenons, for example, *every* tenon fillet is final-machined with a special tool to achieve a precisely contoured fillet. Backing this is careful control of amplitude throughout the full range of operating speeds. Result—sound, stable blading with inherent extra strength.

Every Westinghouse turbine user has the advantage of this combination of design excellence and manufacturing skill. It is responsible for the many features in all Westinghouse General-Purpose Turbines.

For full information on these advanced turbines—and sound advice on your steam applications call your Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-50562

Type E-220 General-Purpose Turbine

This high-speed, multi-stage turbine, 500 hp to 5000 hp, is ideal for drives requiring speeds up to 10,500 rpm. It incorporates all the features and considerations of the rugged, reliable, single-stage Type E.

Turbines for every industrial use

YOU CAN BE **SURE**... IF IT'S

Westinghouse

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DUAL CONTROL means ECONOMY

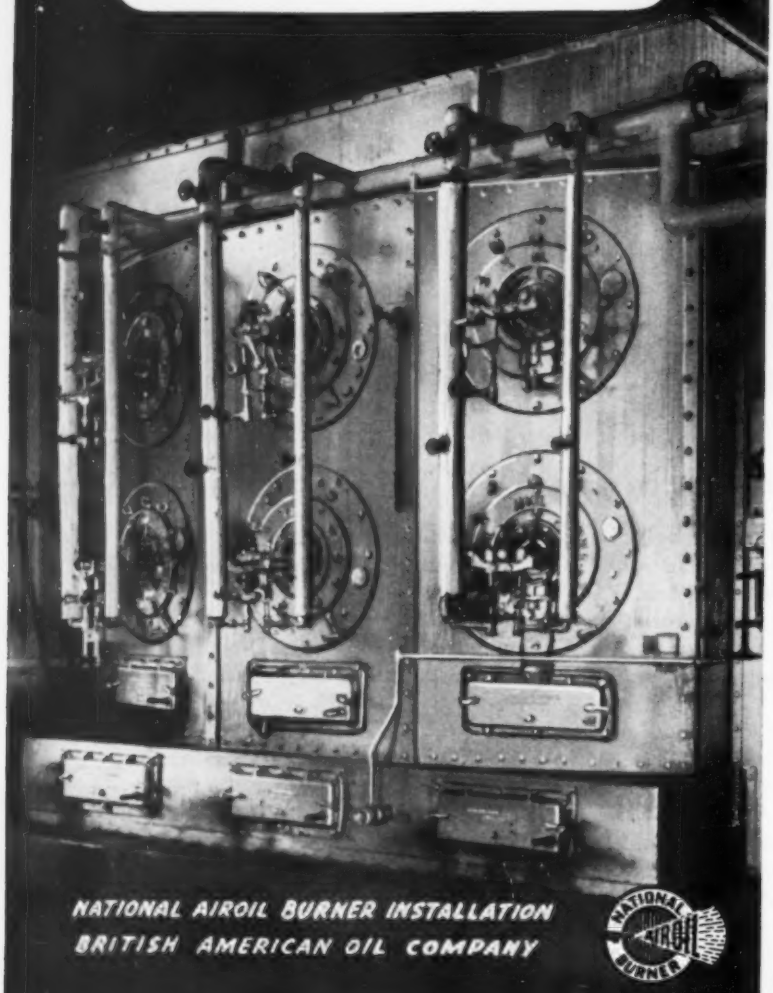
with NATIONAL AIROIL Universal Registers

AND TYPE "S-A-L" OIL BURNERS

. . . and economy means that you get better performance with NATIONAL AIROIL Universal Registers because they have a dual feature for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disk control. Both adjustments can be made while the Type "S-A-L" Oil Burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil.

Universal Registers with Type "S-A-L" Burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.



NATIONAL AIROIL BURNER INSTALLATION
BRITISH AMERICAN OIL COMPANY

NATIONAL AIROIL BURNER CO., INC.

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Southwestern Division: 2312 South Boulevard, Houston 6, Texas
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

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out and make complete replacement necessary.

We had an unattended power plant located about a half a mile from the shop; and to warn of any impending stripping of the gears, we had a telephone bell-ringing magnet operating continuously from the vertical shaft, with a trigger arranged to close the circuit when the gear was lowered to the danger point. This would ring the phone in the boiler room at the shop, where a standing order was posted, instructing whoever heard a persistent ringing of the phone to take the nearest means of transportation (usually a Model T Ford), dash post haste to the water power plant, and shut the wheel down before the gears stripped.

The plant was located on the North Branch of the Nashua River in Leominster, Mass., but flood and fire have now all but erased it from the scene.

MORGAN M. WHITNEY
New York City

Used up to 7 Yrs. Ago—With Suet

THE ARTICLE about wood bearings by Robert H. Rogers in the February issue speaks of the wood bearings as a thing in the ancient past.

At our plant (Cattaraugus Cutlery Co.) similar bearings were used exclusively up to seven years ago on the large hand grinding stones. These stones measured 6 ft in diameter and weighed 700 lb.

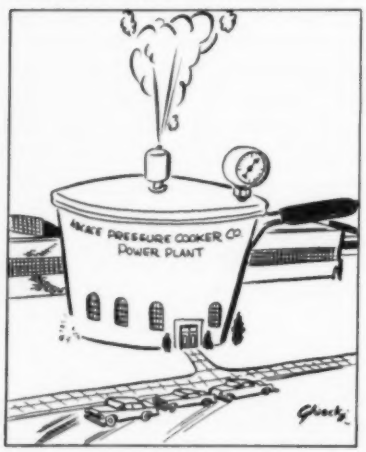
The arbor was a 2-in. shaft which had for bearings pieces of apple wood that were boiled in tallow and only the lower half was used, the weight of the wheel keeping it in the bearing. A piece of suet was always kept riding the top part of the shaft.

One day, when we were dynamiting a cesspool, the impact jumped one of these wheels out of its trough and sent it through a solid brick wall.

Needless to say, since that time roller bearings have been used.

P. T. CHAMPLIN, JR.
Little Valley, N. Y.

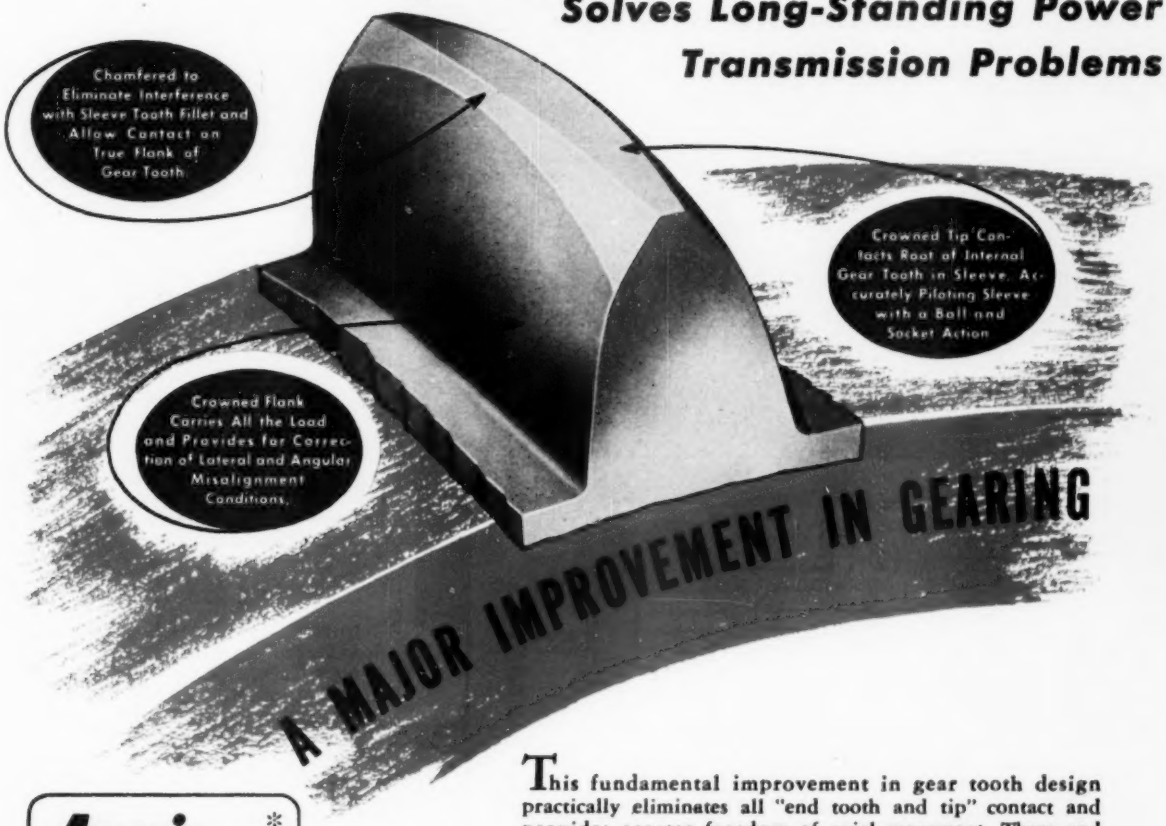
Editor's Note: — These nostalgic comments on lignum vitae and other wood bearings indicate there are a few ex-New Englanders still around.



THE Amerigear* FULLY CROWNED TOOTH DESIGN

*Trade Mark Reg.

Solves Long-Standing Power Transmission Problems


Chamfered to Eliminate Interference with Sleeve Tooth Fillet and Allow Contact on True Flank of Gear Tooth
Crowned Tip Contacts Root of Internal Gear Tooth in Sleeve. Accurately Pilating Sleeve with a Ball and Socket Action
Crowned Flank Carries All the Load and Provides for Correction of Lateral and Angular Misalignment Conditions.
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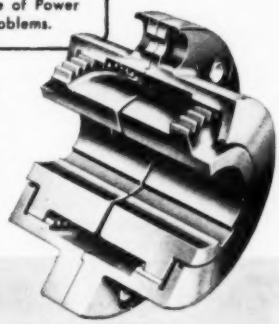
Fully Crowned Tooth Design Solves Wide Range of Power Transmission Problems.



Oil Seals of Amerigear Couplings Are As Advanced in Design, Performance, and Effectiveness As Is the Amerigear Fully Crowned Tooth.

Comparison of Amerigear Fully Crowned Tooth Design With Gearing of Conventional Gear-Type Couplings Shows How "End Tooth and Tip" Contact Is Practically Eliminated and Why Greater Freedom of Axial Movement Is Provided by Amerigear Fully Crowned Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling.)

This fundamental improvement in gear tooth design practically eliminates all "end tooth and tip" contact and provides greater freedom of axial movement. These and other exclusive advantages of Amerigear Couplings distinguish them from common gear-type couplings. There are numerous instances where the fully crowned tooth design of Amerigear Couplings has been utilized to simplify power transmission mechanisms and add reliability to performance in a measure heretofore considered impossible.

Amerigear Couplings offer many more advantages than are obtainable with common basic designs. If your problem arises from excessive offset or angular misalignment, tight backlash requirement, space limitations, high speeds and loads, or any combination of these, it can be solved by the use of Amerigear Couplings. Amerigear Engineers are available for consultation.

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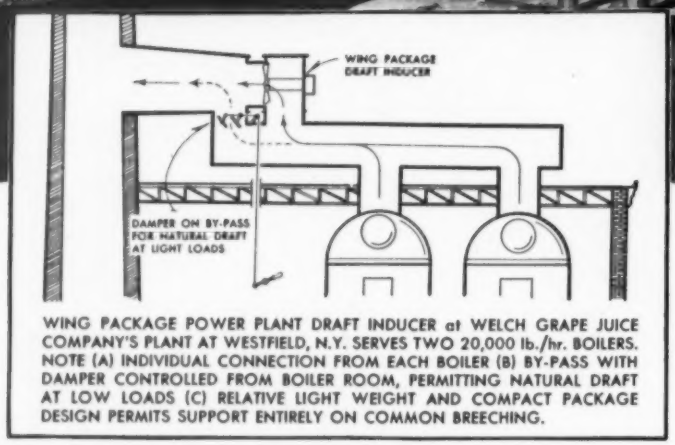
The WING Package DRAFT INDUCER



WING PACKAGE POWER PLANT DRAFT INDUCER at WELCH GRAPE JUICE COMPANY'S PLANT AT WESTFIELD, N.Y. SERVES TWO 20,000 lb./hr. BOILERS. NOTE (A) INDIVIDUAL CONNECTION FROM EACH BOILER (B) BY-PASS WITH DAMPER CONTROLLED FROM BOILER ROOM, PERMITTING NATURAL DRAFT AT LOW LOADS (C) RELATIVE LIGHT WEIGHT AND COMPACT PACKAGE DESIGN PERMITS SUPPORT ENTIRELY ON COMMON BREECHING.

The WING Package DRAFT INDUCER is unique in that the motor (or turbine) and fan is designed as one complete removable unit, making installation easier and being easily removed, facilitates inspection and maintenance. Other advantages are:

1. Big savings in space requirements
2. Permits fewer and lighter structural supports
3. Eliminates field line-up problems
4. Eliminates water cooling
5. Only two support bearings
6. Wide flexibility in gas outlets
7. Saves on investment and maintenance
8. Low load ratings on natural draft because of ample free gas travel area

Write for complete details

Wing

L. J. Wing Mfg. Co.
64 Vreeland Mills Road
Linden, New Jersey

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Obituaries

L. D. Rigdon

L. D. RIGDON, 67, consultant to the manufacturing vice president of the Westinghouse Electric Corp., died suddenly at his home in Pittsburgh.

Mr. Rigdon was born in Pittsburgh and was graduated from the Carnegie Institute of Technology in 1908 with the degree of bachelor of science in electrical engineering. He joined Westinghouse in 1909, and most of his experience with the company was in an executive capacity in connection with shop methods and equipment.

During World War II he was manager of manufacturing for the company's emergency products division with general supervision of operations at naval ordnance plants operated by Westinghouse at Canton, Ohio, Louisville, Ky. and Center Line, Mich. He also was responsible for over-all liaison work between the ordnance plants and the Navy.

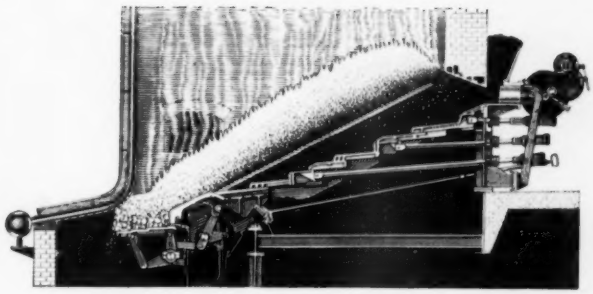
John C. Parker

JOHN C. PARKER, 73, retired vice president of Consolidated Edison Co. of New York, Inc., died last April in Brooklyn following a short illness.

Mr. Parker was graduated in mechanical engineering from the University of Michigan in 1901. Following an apprenticeship with the General Electric Co., he became an instructor in electrical engineering at Union College, and later served for nine years as a mechanical and electrical engineer for the Rochester Railway and Light Co. For seven years he was professor of electrical engineeering at the University of Michigan and received doctorates in electrical engineering from Michigan and Stevens Institute of Technology.

Joining the Brooklyn Edison Co. as an electrical engineer in 1922, Mr. Parker became vice president in charge of all the company's engineering. In the latter capacity he directed the design and construction of the Hudson Ave. generating station, the largest steam-electric station in the world. Serving as president of the company from 1932 to 1936, he became vice president of Consolidated Edison Co. of New York, Inc., upon its merger with Brooklyn Edison in 1936.

During World War II, Mr. Parker was a consultant to the War Production Board and organized the Office of War Utilities under the Office of Production Management. Appointed a member of the National Technological Advisory Commission by the Secretary of War, he was also a consultant to the War Manpower Commission, Foreign Economic Adminis-



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5 ways better than aspirin

FIVE DIFFERENT HEADACHES have often been inseparably connected with stoker operation... and every one of them is eliminated by the modern, engineered AE Taylor Stoker.

CO_2? That's where Taylors give you unrivaled efficiency. *Quick load response?... complete dependability?* Taylor Stokers are completely tops in both respects. *Stack discharge nuisance?* Taylors meet the toughest municipal ordinances. With proper grate area, over 98% of the ash goes to the pit. *Burning versatility?* Properly proportioned, Taylors can and do burn coals satisfactorily from all over the U.S., and from Canada, England and the Continent as well.

Whether your new plant must generate 20,000 or 500,000 pounds of steam per hour, ask your Consulting Engineer about Taylor Stokers. And write us today for booklet telling the whole Taylor story.

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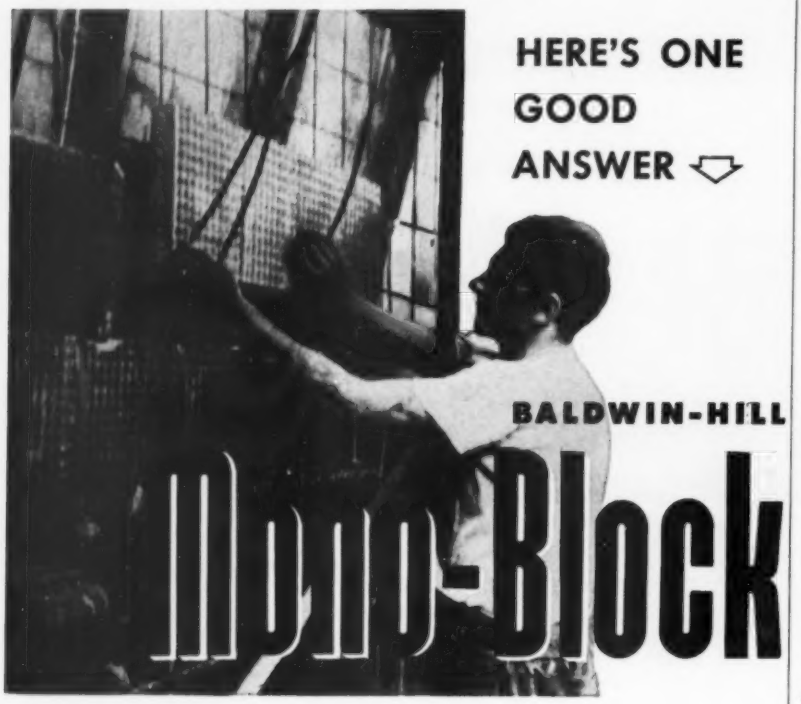
If you're scanning ***Power Engineering*** *for help on insulating problems . . .*



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tration, and played an important role in the World Power Conference.

A former president of the American Institute of Electrical Engineers, Mr. Parker was associated with the Foundation for Economic Education and the National Conference Board. For more than 30 years he was active in the Edison Electric Institute.

Fremont Leslie Lovett

FINAL RITES for Fremont Leslie Lovett, 64, president of Rockland Light and Power Co., Nyack, N. Y., who was killed in June in the accidental crash of his plane near Warren, Vt., took place in The Federal Church, Waitsfield, Vt. Burial was at Warren, Vt.

F. L. Lovett

A native of Warren, Mr. Lovett was graduated from Norwich University in 1913 with bachelor of science and electrical engineering degrees. He worked as an electrical engineer for the Worcester Electric Light Co., Worcester, Mass., from 1914 until 1921, when he was appointed manager of the Montpelier and Barre Light and Power Co., Montpelier, Vt. He served concurrently as secretary and manager of Green Mountain Power Co., Montpelier, Vt.

In 1927, Mr. Lovett was named general manager of Rockland Light and Power Co., Rockland Electric Co., and Pike County Light and Power Co. He served as vice president, general manager, and a director of these companies from 1936 until December, 1951 when he was elected president of the three utilities. He had been a director of Brockton Gas Light Co., Brockton, Mass., since 1940.

Edward C. Badeau

EDWARD C. BADEAU, 58, in charge of the special publications section of The International Nickel Co., Inc., and editor of *Inco Magazine* died in May in Staten Island, New York, following a heart attack. He had resided in New Brighton, S.I., New York.

Mr. Badeau joined International Nickel in April, 1929. A veteran of the Mexican Border Campaign and World War I, he was First County

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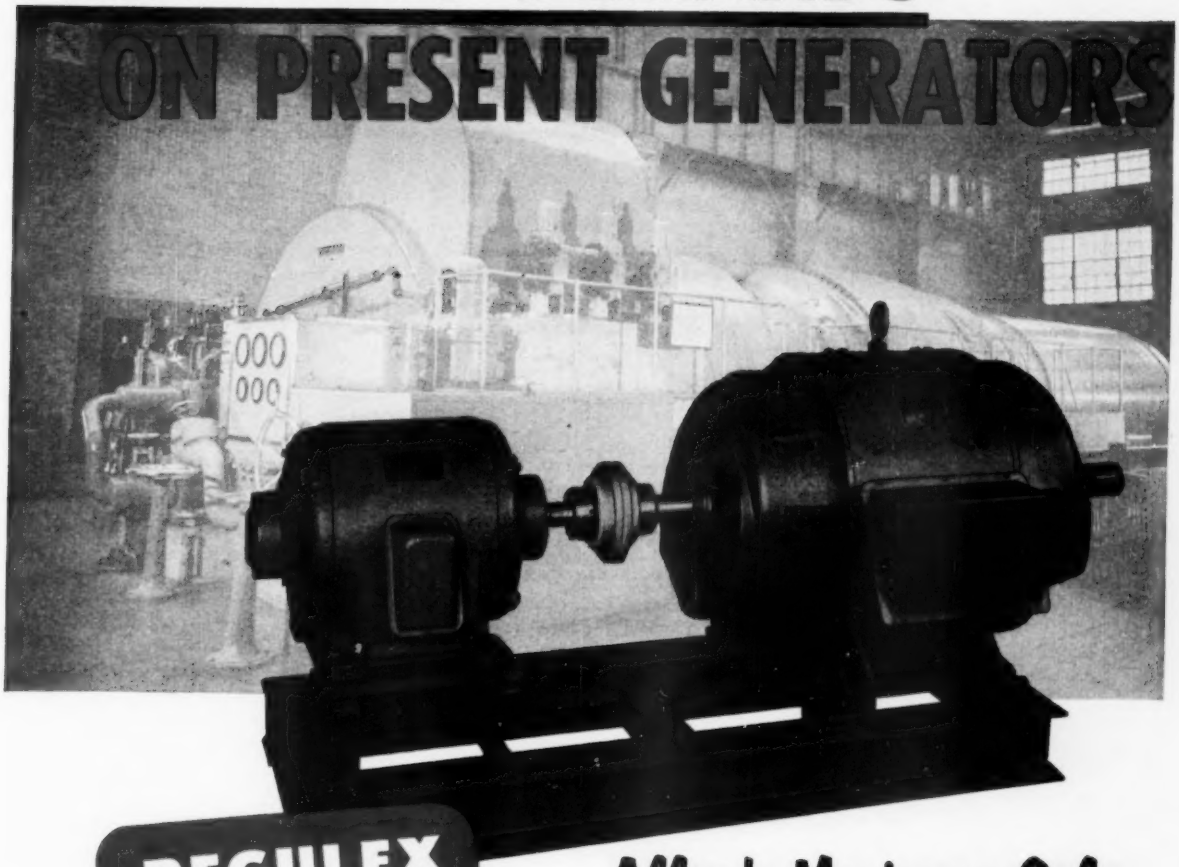

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Commander of Richmond County of the American Legion and Senior Past Commander of the James S. Slosson Post of Staten Island. After the war he was public relations officer of the Near East Relief. Later he established and was publisher and editor of the *South Shore Times*, a former Republican political publication on Staten Island. Mr. Badeau was a past president of the International Council of Industrial Editors.

New ENGINEERING BOOKS

Industrial Water Analysis, prepared by Power Chemical Division, E. F. Drew & Co., Inc.; 54 pages; illustrated; size 8½ x 11 in.; paper binding; published by E. F. Drew & Company, Inc., 15 East 26th Street, New York 10, N. Y. Price $1.00.

The booklet covers in detail boiler water sampling, expression of results, test equipment and general water analysis. It also outlines special tests for versenate hardness and other details related to water analysis, also specific tests for dissolved oxygen, total solids, steam purity by conductance, corrosion tests by NDHA methods.

The book is quite specific and detailed but it is written for use by operators and non-chemists, and contains a minimum of the theoretical chemistry underlying the whole subject. Many of the data are presented in the form of tables and graphs; and specific examples worked out numerically are included wherever possible.

It will prove extremely useful to all power engineers who have to test water themselves and who want to know how it is done by others.

★ ★ ★

Forging and Forming Metals by S. E. Rusinoff. Size 5½ by 8¼ in.; 279 pp; illustrated; cloth bound. Published by American Technical Society, 848 East 58th St. Chicago 37, Ill. Price $3.95.

The art of manually and mechanically shaping metals to desired form is aptly covered by this new book. Well chosen illustrations of various methods bolster the text material in bringing before the reader a broad picture of industrial forging and forming.

The book, however, is not strictly devoted to discussions on forging and forging methods. It covers cleaning, testing, finishing and inspection of forgings. Space is also given to the design of tools and dies for forging and product design.

Here are a few of the 24 chapters in this book: metal quality; impact-die or drop forging; safety in forging operations; upset forging and standard practices; tolerances; impact die forging.

Thermodynamics; Lefax Data Sheets; size 4 by 7 in.; paper binding; published by Lefax, Philadelphia 7, Pa.; price $1.00.

These pocket-size loose-leaf data sheets cover tables and charts on such subjects as: thermodynamic properties of ammonia, liquid ammonia, butadiene; properties of solid and saturated carbon dioxide, superheated carbon dioxide; compressed air; heats of combustion of crude oils, fuel oils, and kerosenes; properties of Dowtherm A, refrigerants, methyl chloride; and many other tables and charts.

★ ★ ★

Fifty-Year Index to ASTM Technical Papers and Reports; size 6 by 9 in.; 207 pp; cloth bound; published by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.; price $6.00.

This fifty-year index provides a detailed author and subject index to all technical papers and reports dealing with materials, particularly their properties and testing, appearing in ASTM publications covering the period from 1898 through 1950.

This index is intended to make readily available to the materials technologist, the researcher, the librarian, and all others concerned with the fields covered, pertinent information on a particular subject. This effort has been made, after consultation with many users of indexes.

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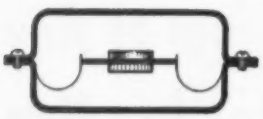

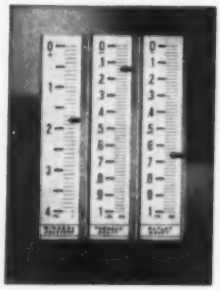

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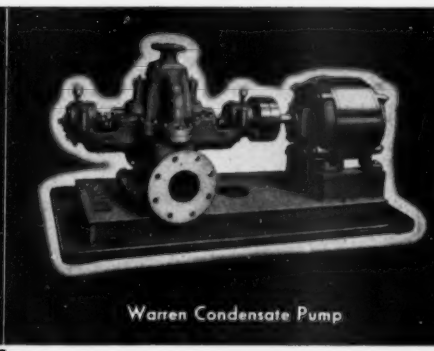
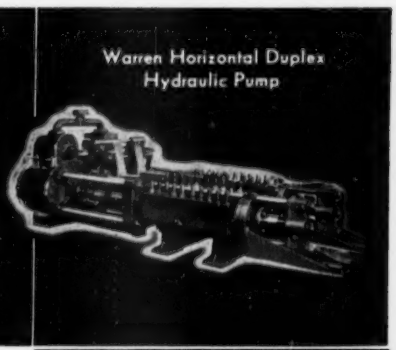
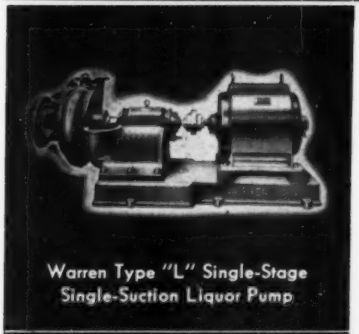

Warren Condensate Pump


Warren Horizontal Duplex Hydraulic Pump


Warren Type "L" Single-Stage Single-Suction Liquor Pump

There's a Warren or Warren-Quimby Pump for practically all industrial pumping applications, and our large variety of types and sizes assures an unbiased recommendation. The value of this should not be underestimated because a recommendation that barely meets operating conditions and requirements can prove to be anything but a profitable long range investment, regardless of any initial advantage in cost.

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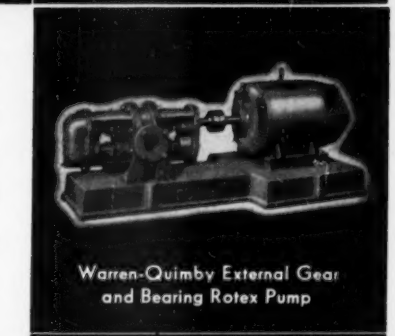
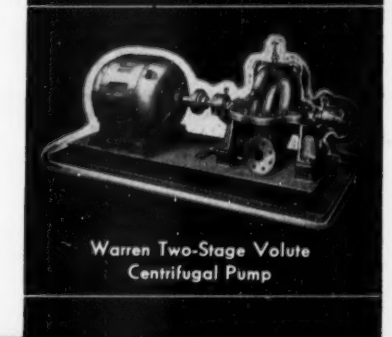

Warren-Quimby External Gear and Bearing Rotex Pump

Warren Type DBL, Single-Stage Double Suction, Centrifugal Pump


Warren Two-Stage Volute Centrifugal Pump

WARREN QUIMBY PUMPS

WARREN STEAM PUMP COMPANY, INC.

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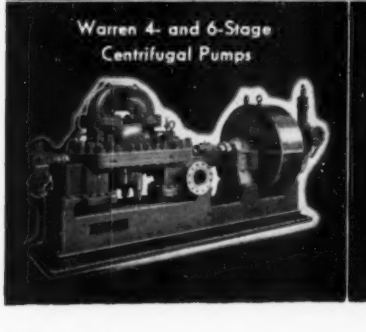
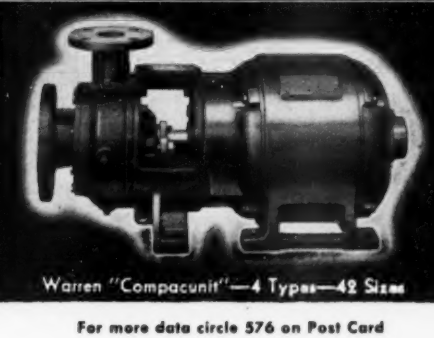
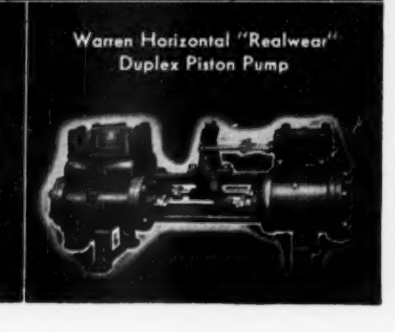

Warren 4- and 6-Stage Centrifugal Pumps


Warren "Compacunit"—4 Types—42 Sizes


Warren Horizontal "Realwear" Duplex Piston Pump

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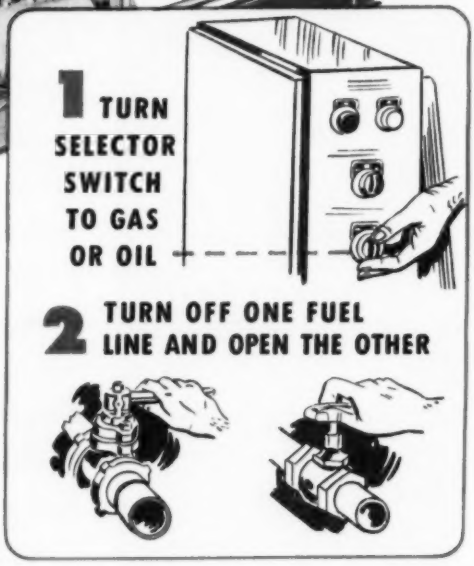

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HELPFUL BULLETINS

(*Continued from page 96*)

127 Transmission, Conveying Equipment — Bulletin 53-110, 56 pp, is described as an abbreviated catalog on cast and steel chains, cast tooth sprockets, belt conveyor idlers and spray nozzles. It presents the story of corrosion- and abrasion-resistant Rex-Z-Metal, gives chain listings and prices and sprocket information. Take-ups, buckets, idlers, spray nozzles and chain attachments are also listed. A pictorial index to equipment covered is included. Chain Belt Co.

128 Bearing Calculator — This calculator is offered to aid in the selection of ball thrust bearings. Its circular sliding scale provides a simple means of converting bearing capacities (load, speed, life) required for a given application into terms of rated bearing capacities. It selects the proper bearing size for the application under consideration without pencil calculations. Reverse side shows company's line, gives condensed specifications. Aetna Ball and Roller Bearing Co.

. . . *Outstanding Among This Month's Catalogs*

129 Manual on Demand Meters — Booklet GET-2327, is a 48-pp well illustrated manual on demand metering. Describes in detail the theory, economics, operation and application of demand meters. Provides an excellent summary of principles and problems of demand metering; a reference for helping in specific demand-measuring application; and a simple textbook for trainees. Rather than emphasize details of meter construction, installation or maintenance, this manual serves as a centralized source of basic information. General Electric Co.

130 Industrial Ventilation Guide — Bulletin 1520, 28 pp, presents ventilating problems peculiar to industry and shows some of the ways in which company's equipment is solving those problems. They cover general ventilation, heat and steam exhaust, smoke and fume exhaust, air circulation, equipment cooling, dust removal, air filtering, heating. Includes data on air change requirements, information on fan selection, use and location of ducts with propeller fans, other helpful data. Generously illustrated with installation photos. Ilg Electric Ventilating Co.

COMMUNICATION

132 How to Use Sound Signals — This new 44-pp combination manual, data book and catalog is an excellent reference work on industrial sound signals. Includes a simplified explanation of fundamentals of sound; a glossary of sound and signal terminology; a quick-comparison guide for selecting equipment; suggested steps in choosing a signal installation, and hints for compiling a coding signal call system. One section of the book is devoted to specifications and listings of manufacturer's signal equipment, and includes construction features, typical applications, dimensions and decibel output at various distances. Benjamin Electric Mfg. Co.

133 Inter-Com System — Bulletin 28 describes and pictures the Femco Page-phone system which provides clear speech over telephone-type handsets, plus an all-hear paging feature utilizing a loudspeaker. Stresses economy of the system which uses one central amplifier, one common cable and requires no operator. Farmers Engineering & Mfg. Co.

134 Industrial Television Equipment — Catalog E describes and pictures camera, monitor and viewing equipment for use in industrial televiewing applications. Explains operation, special features, lists some of the jobs this equipment can perform. Radio Corp. of America.

OTHER EQUIPMENT

135 Fuel Burning System — A factory-coordinated industrial fuel burning system for the conversion of large boilers to oil or gas firing is presented in 16-pp Form ID-53. Well illustrated, booklet explains what the system is, what it offers. Pictures component parts and stresses installation simplicity, precision combustion afforded. Detailed information is given on windbox assembly, control panels, burners. York Shipley, Inc.

136 Pneumatic Spreader Stokers — Twelve-pp Catalog 2530 illustrates in color and describes pneumatic spreader stokers for bituminous, sub-bituminous, high ash fusion, and lignite coals. Text covers coal conveying, drying and preheating, and automatic firing. Also included is material on automatic combustion controls, dumping grates and fly ash reinjection system. Iron Fireman Mfg. Co.

137 Gravity Filters — Comprehensive, well illustrated Booklet 2539A, 24 pp, shows company's complete line of gravity filters, which are made in three basic types, of concrete, of steel and of wood. Specifications, operating characteristics, outline dimensions and typical installations of the filters and accessories are included. The Permutit Co.

138 Pocket Conversion Table — This little plastic card is imprinted with frequently-used altitude and refrigeration conversion tables. Includes a table converting altitude to pressure in inches of mercury, psi, and millimeters of mercury. The reverse side shows pressures of Freon 13, 22, 12 and 14 over a wide range of temperatures. Tenney Engineering, Inc.

139 Insulation Surfacing Specifications — Specifications for the protective surfacing of high-, low-, or dual-temperature insulations exposed to normal, chemical and physical abuse, indoors or outdoors, are available. A handy index shows company's specifications applicable to each insulation surfacing problem and insulating material. Benjamin Foster Co.

140 Belt Conveyor Carriers — Carriers designed for rugged jobs, exposure to dust and long service are the subject of illustrated Bulletin 453. Shows how their spun end rolls and welded steel frame contribute to extra strength and better balance. Stephens-Adamson Mfg. Co.

141 Hard-Working Tractor — Bulletin TD-216 is a 28-pp booklet describing and picturing the Tournatractor, a high-speed, electrical control, rubber-tired tractor available with 10 interchangeable attachments. Action shots and photos of integral parts of the machine show how and why it gets more work done, reduces maintenance, saves time and money. Fingertip control system, instant shift transmission are illustrated. R. G. LeTourneau, Inc.

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Catalog Library

THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, may appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the catalogs and bulletins. Use the postage-free card below for your request

ELECTRICAL

201 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors and controls is provided. Westinghouse Electric Corp.

202 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. United States Rubber Co.

203 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

204 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and representative dimensions. Allis-Chalmers Mfg. Co.

205 Totally-Enclosed Motors — Eight-pp Form 1784, illustrated in full color, presents a line of totally enclosed motors, including types for both hazardous and non-hazardous locations. Design details of the motors are shown in a large cutaway drawing, and special construction features are pictured. Includes application information on both explosion-proof and non-explosion-proof motors in this group. U. S. Electrical Motors, Inc.

206 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

INSTRUMENTS AND CONTROLS

207 Supervisory Instruments — Catalog 90-2. "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation and other variables discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

208 Industrial Thermometers — Catalog 125, 28 pp, presents ordering data on a wide range of industrial thermometers, giving scale ranges, dimensions and prices. Features company's Adjust-Angle thermometer designed for use at any angle front to back, left or right, through a 180 deg arc. Gives construction details and advantages of this adjustable-stem type instrument. Weksler Thermometer Corp.

209 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

210 Sight Glass Flow Indicators — Twelve-pp Bulletin 18-W, on company's line of flow indicators, shows how these mechanical devices indicate fluid flow and its direction in pipelines which can be directly observed through a sight glass and are suitable for service with liquid, gas, vapor, slurry or sludge sufficiently translucent to permit observation of indicating element. Schutte and Koerting Co.

211 Steam Specialties — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

212 How to Select Regulators — This 36-pp, illustrated "step selection chart" simplifies choice of proper type and size of pressure regulator, temperature regulator or pump governor to do a specific job. Written in nontechnical language and supplemented by steam, gas and water capacity tables, this booklet includes installation suggestions, conversion tables and other data. Foster Engineering Co.

August 1953
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POWER ENGINEERING

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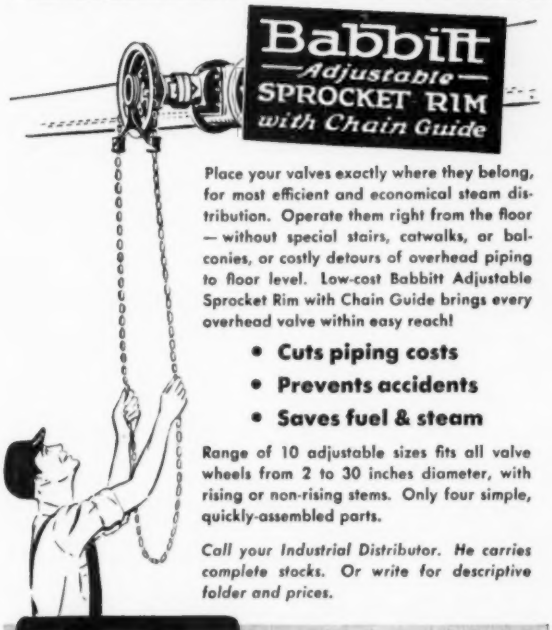

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Conserve those valuable condenser tubes...

the Wilson Way

Usually a surface condenser tube fails in the first few inches of its length due to inlet end erosion. To protect against this costly deterioration, it is good practice to paint the tube sheets as well as the tube ends with a protective coating. This low-cost cleaning and application kit is designed to do the job quickly and efficiently. Only three simple steps are needed: (1) Clean all the tube ends. (2) Thin coating and squirt it into tube. (3) Attach the paint brush to the air motor and use it for fast, easy spreading.

This Wilson method insures complete removal of dirt, provides excellent paint adherence, makes certain paint is spread evenly on the tube. The work can be done in a hurry . . . with any labor available.

The Wilson Cleaning and Application Kit is but one of many Wilson accessories designed for the proper maintenance of condensers and heat exchangers. For packed condensers, there are packing tools, packing removal counterbores and ferrule wrenches. Wilson also makes a wide range line of tube cutters, tube expanders, flaring and belling tools, tube pullers, etc. TW 822

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TUBE CLEANERS • TUBE EXPANDERS

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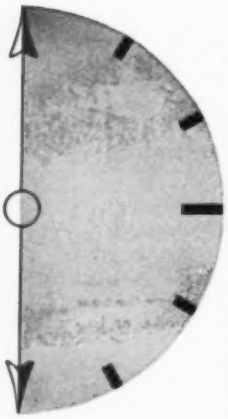
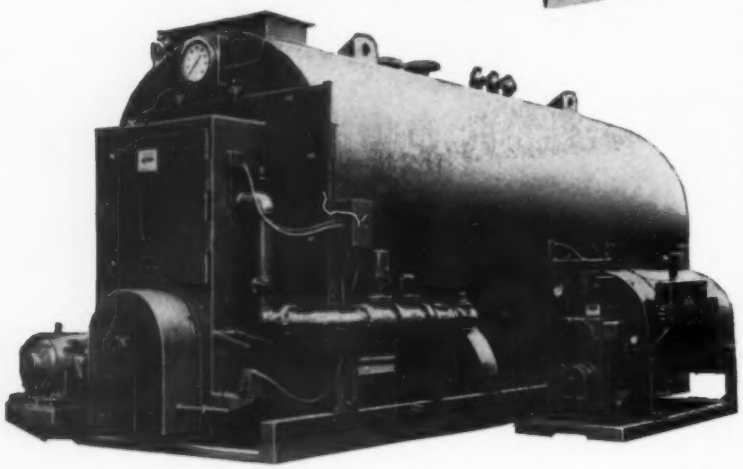
. . . it takes only 30 minutes to open a

Continental Boiler

for cleaning or inspection



Sizes from 20 to 500 hp, high or low pressure



With a Continental you'll hold boiler down-time to a minimum because the clean-out-and-inspection-doors at both ends are hinged and can be handled *easily* by *one* man.

But that's only one of the construction features. Here are others:

ADVANCED TWO PASS DESIGN—eliminates baffles that may break during operation, causing gases to by-pass and destroy efficiency. *With the Continental,* 80% efficiency is *guaranteed.*

LONG SERVICE LIFE—The use of forced draft and the elimination of baffles results in uniform distribution of heat through all tubes. This insures long life because all tubes do equal work.

MAXIMUM HEAT TRANSFER—Fuel is not burned in a refractory-lined furnace but is fired directly into the firing tube which is surrounded by water. This assures maximum heat transfer, complete combustion, a high CO_2 and a low stack temperature.

BURNERS—OIL AND GAS—*Continental's exclusive firing method saves fuel.* The *oil burner* uses a pressure atomizing type nozzle which is easy to service—no cups or moving parts to wear out. The *gas burner*—rather than premixing—mixes the fuel and air at the point of ignition, thus producing a uniform, highly radiant flame.

Continental Boilers are shipped tested and ready to operate. No special stack, foundations or connections required.

Find out how low Continental is in *initial* and *operating* cost: Write for Catalog 102.

CONTINENTAL is sold, installed and serviced by competent distributors throughout the U. S.

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40 Years of Boiler Manufacturing

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213 Pneumatic Valve Operator — This 8-pp bulletin explains operating principles and outstanding features of the Rotomotor positioning operator for throttling control service. Tells how this heavy duty, all-pneumatic operator is designed to combine safety and economy of air operation with the power of a gear driven screw stem. Conoflow Corp.

214 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

215 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co.

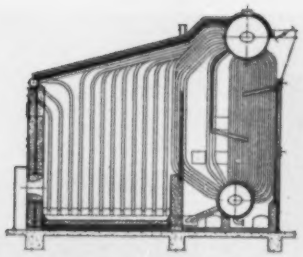
216 Boiler Control — Ten-pp Bulletin 1007 describes a completely integrated system for controlling combustion, feedwater, boiler steam temperature and boiler cleaning, available in a single package or furnished separately. Illustrated with full color drawing of complete control, photos of recorders, drive unit. Covers instrumentation with both miniature and standard instruments. Copes-Vulcan Div., Continental Foundry & Machine Co.

217 Control Centers — This 31-pp application booklet (B-5621) on control centers stresses the case for centralizing all controls of an entire system in one group of enclosures. Discusses the characteristics of control centers that make for flexibility of use, ease of servicing, safety. Three types are described, and the various electrical components that make up typical units are illustrated. A three-step building-block system of planning control centers is given. Westinghouse Electric Corp.

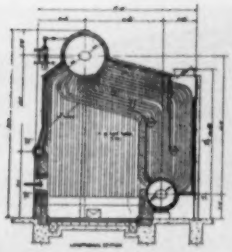
Postage-free cards for ordering these catalogs are on pages 35 and 138. When using them, don't forget to include your job title and company name—even if you want those catalogs to be delivered to your home address

218 For Combining Control Signals — The improved design of company's Ratio Totalizer is described and pictured in 8-pp Bulletin 5452. This simplified versatile mechanism is a pneumatically operated control for combining input control pressures and spring forces, and producing an output control pressure based on addition, subtraction, multiplication, division or other functions. Hagan Corp.

219 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages,



2 Drum Water Tube Boiler



Type-S 2 Drum Boiler Series 51

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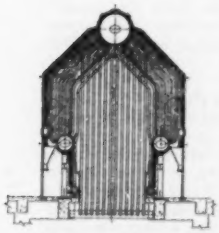
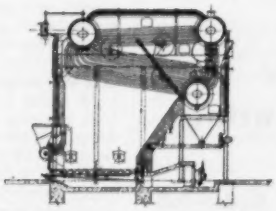
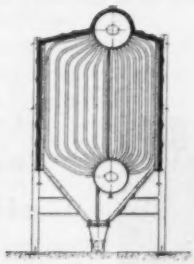
• In the oil, paper and chemical industries and in manufacturing plants, institutions and public buildings throughout the world Wickes Steam Generators are in constant daily service. All types, such as those illustrated on this page, with capacities up to 250,000 lbs. steam per hour and 1000 psi. Write for descriptive literature.



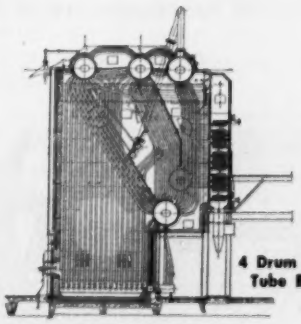
"A" Type Water Tube Boiler



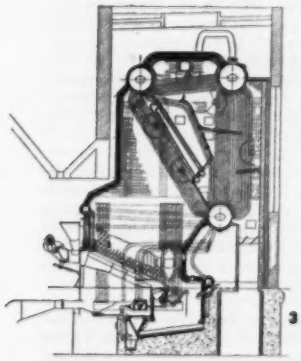
3 Drum Low Head Water Tube Boiler



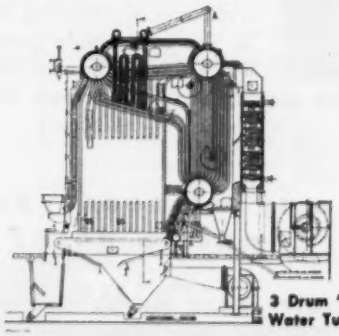
Wickes 2 Drum Waste Heat Installation



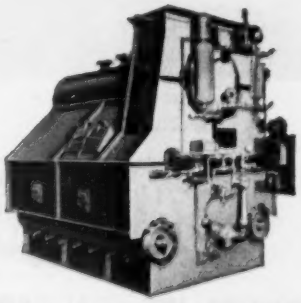
4 Drum Water Tube Boiler



3 Drum Water Tube Boiler



3 Drum "B" Type Water Tube Boiler



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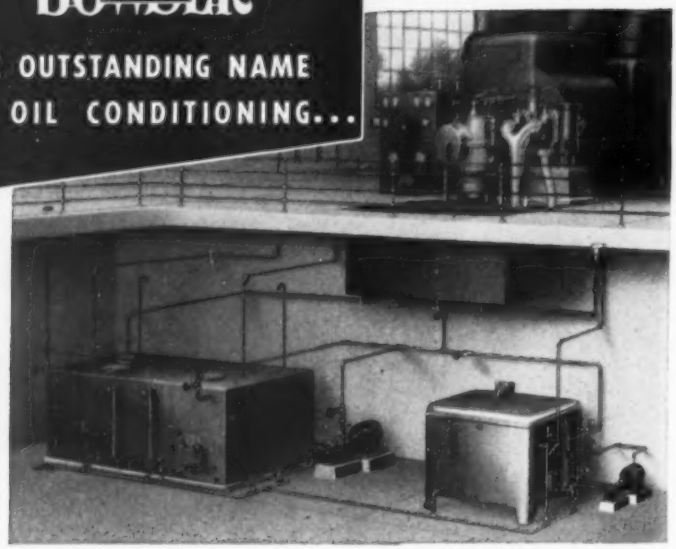
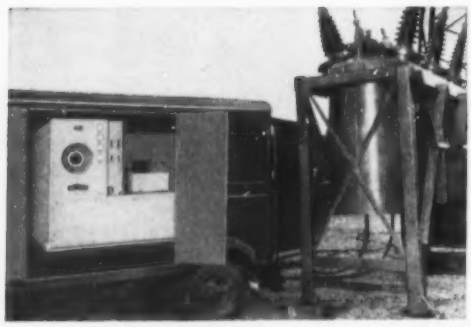


...for power generating equipment!

This Bowser turbine oil conditioning system keeps oil "bone dry" and crystal-clear . . . the best "stay-on-the-job" insurance a turbine bearing can have. Costly bearing failures are avoided and less stand-by equipment is required with Bowser oil conditioners. Turbine oil lasts for years, too! That's why Bowser oil conditioners are on the job in a majority of power plants.



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The Bowser Hydro-Volifier is a conditioning unit for transformer, circuit breaker and switch oils. It restores oil dielectric to 35 k.v. in a single pass while the equipment remains energized . . . no service interruptions with Bowser oil conditioning!

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manometers, valves, venturi tubes. Descriptions of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

220 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

PUMPS, PUMPING

221 Rotary Pump Service Manual — The installation, operation and maintenance of rotary pumps are covered in 12-pp Service Manual 100-2. Subjects discussed include installing of foundation bolts, alignment, supporting vertical pumps, grouting, piping, suction lines, hot liquid pumps, rotation, packing, dismantling, reassembly, starting, operation and standing idle. Warren Steam Pump Co.

222 Condensed Pump Data — Form 4383-J covers more than 20 types of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature providing further information. Goulds Pumps, Inc.

223 Controlled Volume Pumps — Bulletin 351, 16 pp, describes company's air-powered controlled volume pumps, designed to pump practically any liquid in measured volumes accurate to within a fraction of 1 per cent. Pumps are reciprocating, positive displacement plunger types. Cross-sectionals show design and operating details. Controls and typical automatic feed systems are discussed. Milton Roy Co.

224 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

225 For Controlled Volume Pumping — Bulletin 300, 24 pp, describes Pulsafeeder piston-diaphragm pumps, stressing their no-stuffing box feature and noting that although basically a pump, this unit can do the work of a feeder, meter, instrument, filling machine, proportioner and sampler. Process Equipment Div., Lapp Insulator Co., Inc.

226 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data and vapor pressure tables included. Pacific Pumps, Inc.

227 Pumps for Fly Ash — Illustrated Bulletin F-K-16 describes Fuller-Kinyon pumps for conveying dry fly ash. Discusses and illustrates use of these pumps in power generating stations; also includes drawing showing layout of a con-

crete products plant which uses fly ash in the manufacture of its products. Fuller Co.

PACKINGS, GASKETS, SEALS

228 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

229 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

230 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. Illustrated. Includes construction information, sizes. Johns-Manville.

231 Long Wearing Piston Packing — Form 4502, 8 pp, presents composition cups for packing pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures, temperature and pressure data, sizes. Darling Valve & Mfg. Co.

BOILERS, GENERATORS

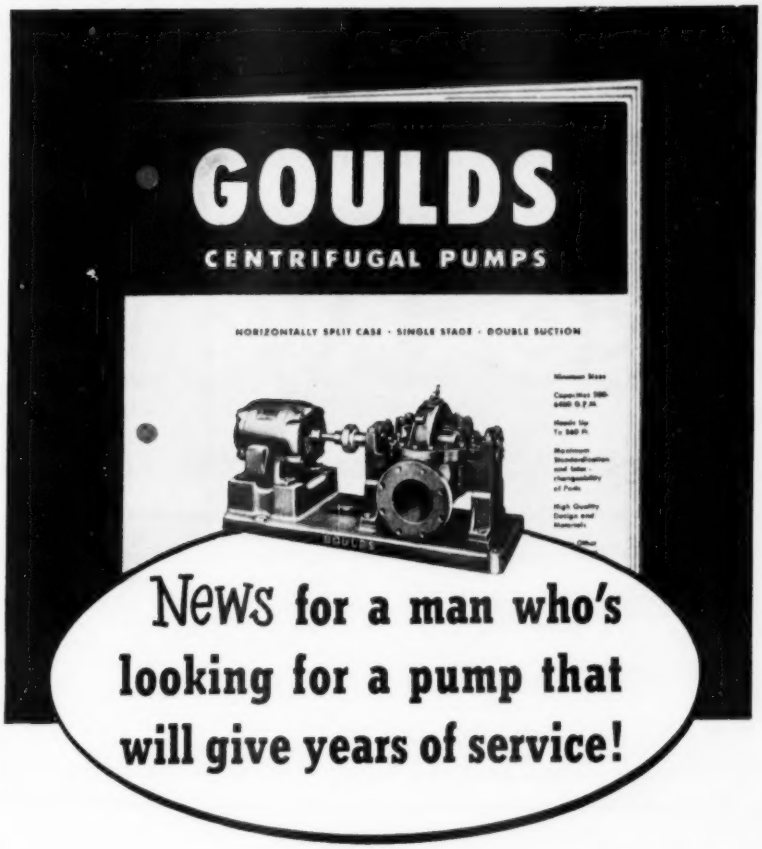
232 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions and standard and accessory equipment for the units which range from 20 to 6000 hp, for pressures to 250 psi. Preferred Utilities Mfg. Corp.

233 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions and weights given. The Babcock & Wilcox Co.

234 Re-circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or where load fluctuates. Combustion Engineering, Inc.

235 Steam Boilers — Form SG 128-749 is a 12 pp catalog illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes diagrammatic cross-section of four-pass design characteristic of company's boilers. Cleaver-Brooks Co.

236 Steam Generators — Twenty-pp Bulletin SB43, 20 pp, describes company's VL factory assembled generators



News for a man who's looking for a pump that will give years of service!

For fifty years we've been learning from our industrial customers what they want in centrifugal pumps.

We've come as close as modern design and materials allow to putting what you've taught us into our new Fig. 3405 pump.

The quality of materials and extras of design that you have been able to get only by paying *extra* are *standard* on this pump: stuffing box bushings, bearing housings sealed against moisture and dirt, stainless steel impeller keys, Teflon water seal rings—just to mention a few.

The Fig. 3405 carries interchangeability of parts far beyond anything we've been able to do before. Only three shaft and impeller assemblies provide for 19 pump sizes, or 38 pump combinations, counting right- and left-hand rotation.

This can mean real spare parts inventory savings for any plant that uses many pumps. It also means easy-to-make field changes to meet new requirements.

You'll find a lot to interest you that we can't tell you about here in the 12-page illustrated bulletin on our new Fig. 3405 pump. We think you'll agree that here's a pump with everything for long, satisfactory service.

Just fill in the coupon to get a copy of the bulletin, pin it to your letterhead and mail it to us at your convenience.

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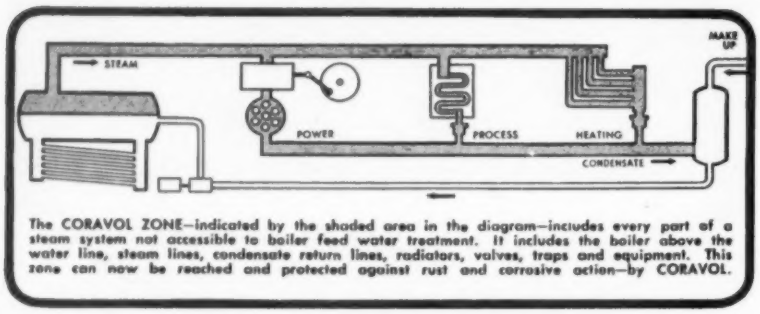

The CORAVOL ZONE—indicated by the shaded area in the diagram—includes every part of a steam system not accessible to boiler feed water treatment. It includes the boiler above the water line, steam lines, condensate return lines, radiators, valves, traps and equipment. This zone can now be reached and protected against rust and corrosive action—by CORAVOL.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special chemical formulas for . . . boiler feed water . . . foam prevention . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

CORAVOL circulating throughout your steam system protects it from corrosive attack. **CORAVOL** saves costly pipe repairs and replacements—maintenance labor—hours and days of shutdown loss. **CORAVOL** cleans out clogging rust deposits, improving heat transfer, restoring original capacity of lines and efficiency of valves and traps.

CORAVOL, the original* amine process, has the flexibility that lets it conform to each individual need. The **CORAVOL** you will use is formulated to do the best protective job under your own plant conditions.

*The use of **CORAVOL** in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

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combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Use of generator with various fuels and firing arrangements is covered. Erie City Iron Works.

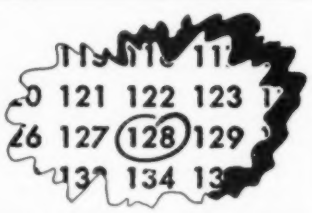
237 Scotch Marine Boilers — Bulletin 236 illustrates and describes a Scotch type of boiler on skids suggested for a wide range of applications. This boiler can be hand- or stoker-fired with coal or can use oil, gas or wood as fuel. Gives construction details, stresses versatility, other advantages. Includes test data and specifications. The James Leffel & Co.

238 Oil or Gas Fired Automatic Boilers — Boiler, burner, controls and safety features of 10 to 500 hp oil or gas fired automatic boilers are described in this bulletin. Firing rates, dimensions and capacities are given for all models along with installation photos of some models. Boiler Engineering & Supply Co.

FUEL OILS, LUBRICANTS

239 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

240 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.



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241 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

242 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated

with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

243 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil. Bowser, Inc.

COAL, ASH HANDLING

244 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. Detroit Stoker Co.

245 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; picture several models. Tractor Div., Allis-Chalmers Mfg. Co.

246 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

247 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

248 Shredder Ring Crusher — A crusher for coal and similar materials which features rolling shredder rings is described in this 8-pp bulletin. Gives details on a survey of 29 mines and power plants in which this type crusher is installed. Informative tables giving speed, capacity, horsepower, weight and dimensions of crushers, as well as cost data are included. American Pulverizer Co.

249 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

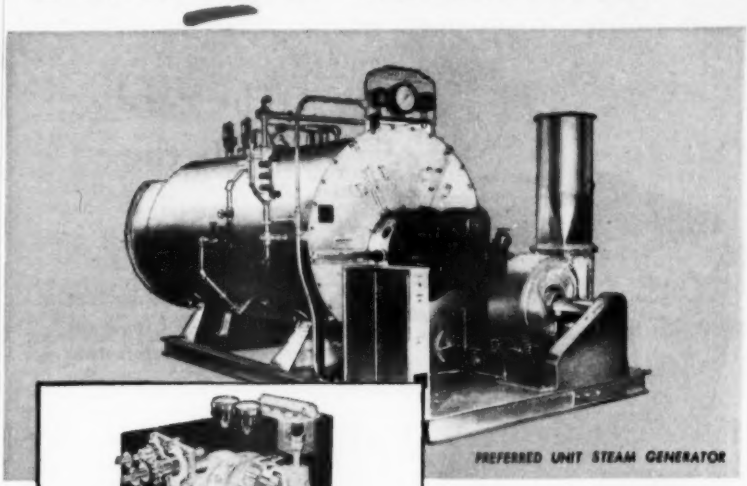
250 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March.

GAS AND OIL BURNERS

251 Gas Burners — Illustrated Bulletin 410–8, 16 pp, furnishes descriptive and technical data on company's gas burners and combination gas and oil burners, giving design details and explaining operation of each. Coppus Engineering Corp.

252 Oil Burning Equipment — Bulletin O-B 37 contains 16 pp of technical

there *IS* a difference*



*Voluvalve Fuel Regulator... another 25 year built in Preferred "Quality Feature" that means accurate, efficient combustion.

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Preferred's Unit Steam Generator handles any and *all* the variations of Bunker "C" and No. 6 oil that are coming through these days from catalytic cracking . . . and they do it *better* and *more efficiently* than any other unit steam generator on the market because—

**No other unit has Preferred's "Voluvalve"* Fuel Regulator! In conjunction with a constant displacement pump the "Voluvalve" — through *positive*, reciprocal proportionate gearing—supplies an exact and accurately metered amount of oil to atomizer or fuel feed system.

**No other unit has Preferred's High-Speed Atomization* —taking the metered fuel, Preferred's rotary cup speeds at *4600 RPM* and easily atomizes the most viscous oil to a fine spray. Higher air velocities provide for greater collision effect and better atomization and allow complete control of spray angulation for carbon-free operation.

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information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows fuel oil pumping, heating systems. The Engineer Co.

253 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. National Airoil Burner Co., Inc.

TUBING AND ACCESSORIES

254 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are presented, as are specifications, conversion tables, weights of tubes and alloys. Scovill Mfg. Co.

255 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

256 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

257 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

258 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

259 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

260 To Avoid Tube Corrosion — Bulletin TR-514 is an 8-pp illustrated article discussing corrosion as a major factor in shortening the life of boiler tubes. Indicates that, in low pressure boilers, corrosion is the largest single cause for re-

placement of tubes. Points out types and causes of corrosion and gives general rules to follow to get maximum service life from boiler tubing. Tubular Products Div., The Babcock & Wilcox Co.

HEAT EXCHANGING, COOLING

261 Heat Exchangers — The advantages of film-type heat exchangers in the solution of cooling water problems, even when dirty water must be used, are stressed in Bulletin HE-7, 8 pp. Explains and illustrates design details. Discusses use of these heat exchangers in power plants, chemical plants, and in a compression plant. Henry Vogt Machine Co.

262 Finned Tube Heat Exchanger — Bulletin 1400, 20 pp, fully describes the company's G-R Twin G-Fin Section heat exchanger. The unit has wide application for heating and cooling liquids and gases, and for condensing vapors, according to the company. Suitable as boiler feedwater preheaters, fuel oil heaters, etc., features of design and construction are given. Griscom-Russell Co.

263 Heat Exchanger for Process Industries — Bulletin HF-101, 8 pp., describes the Holo-Flight Processor. Tells how this heat exchanger affords control of the flow of material as to duration of treatment, and control of the quantity and temperature of heat exchange agent. Western Precipitation Corp.

264 Air-Cooled Heat Exchangers — Technical Bulletin R-53-DC1 is a 6-pp illustrated article on the economics of the air-cooled heat exchanger for process cooling. Discusses air-cooled exchangers and their selection, gives design details that affect cost and evaluates operating costs. The Marley Co.

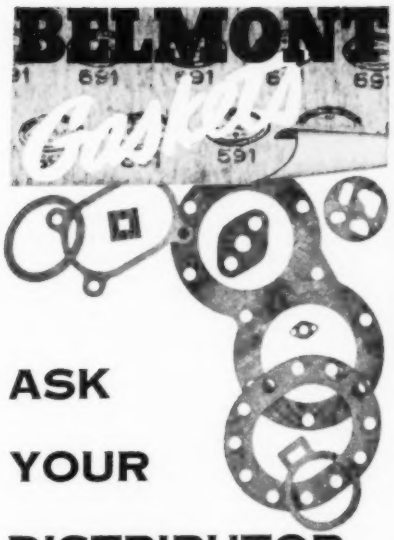
VALVES, TRAPS, PIPING AND ACCESSORIES

265 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, and also tables on superheat correction factor. Manning, Maxwell & Moore. Inc.

266 For Quick Valve Selection — Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and thumb indexed, includes pressure-temperature chart. The Ohio Injector Co.

267 Valve Specialties — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves Davis Regulator Co.

268 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.



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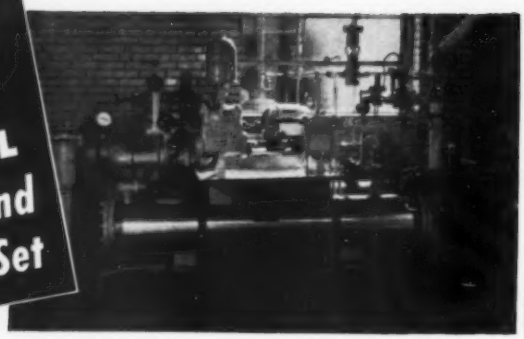

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269 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

270 Cast Steel Valves — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

271 Gate Valves — Literature is available on cast steel outside-stem-and-yoke gate valves; also on bronze, iron, steel and corrosion-resisting valves in a variety of types. The Wm. Powell Co.

272 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

273 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manual and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages of the valves are discussed. R. S. Products Corp.

274 Solving Steam Trap Problems — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

The postage-free cards on pages 35 and 138 may also be used to ask for information on advertised products. Just circle the number appearing below or above the ad

275 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

276 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of

company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring Co.

277 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb, expansion steam traps, weight-operated traps for steam, air and gasoline, also piston-operated traps. W. H. Nicholson & Co.

278 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how to-do-it features. Includes 8-pp valve selection guide. Crane Co.

279 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

280 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

281 Forged Fittings — Literature is available on screw-end and socket-weld fittings. Stresses economy and other advantages of these fittings, lists steels available. Watson-Stillman.

REFRACTORIES, INSULATION

282 Refractory Cements — Sixteen-pp Form 863, presenting a line of refractory cements, discusses the three basic materials used in them, provides a detailed selection guide and illustrated discussion on methods of preparation and installation. Also defines terminology. Norton Co.

283 Heat Insulation Data — This is a 12-pp illustrated engineering and specification manual describing applications for 85 per cent Magnesia heat insulation. Provides data on heat savings per pipe thickness, for heat ranges to 600 F. Includes charts for determining thickness standards for pipe covering, with tables for heat calculations. Mundet Cork Corp.

WATER CONDITIONING

284 Water Conditioning Data Book — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater make-up requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

285 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super

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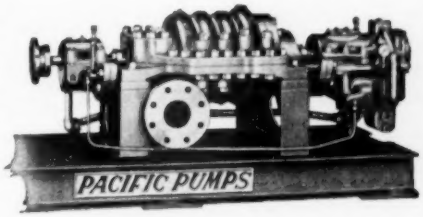

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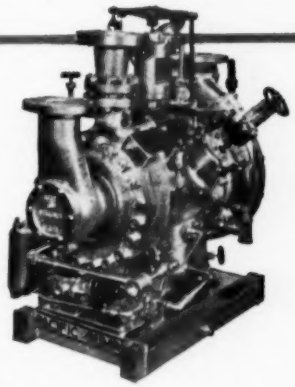

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Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

286 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

287 Steam System Treatment — This bulletin on Coravol for prevention of corrosion, explains theory of corrosion, application of organic amines to steam systems (the Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing special chemical formulas for treatment of water, steam, brine and fuel. Western Chemical Co.

288 Boiler Scale — Formation and Prevention — Technical Paper 98 is a 12-pp article covering the cause and prevention of boiler scale. Covers the mechanism of scale formation, effect of boiler scale, chemistry of scale formation, internal chemical treatment and chemical correctives. Diagrams of feeder systems, photos and solubility charts illustrate text. W. H. & L. D. Betz.

289 Data on Zeolite Softeners — Publication 4520-A is a 32-pp well illustrated booklet on zeolite water softening. Provides a glossary of terms used in the process, data for laying out a zeolite softening plant, factors governing size of equipment, selection of Zeolite materials and discussion of operating stages of a sodium zeolite softener. Cochrane Corp.

290 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising pH value of condensate. The Bird-Archer Co.

291 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50. Procedures, reagents, and equipment are described. Hall Laboratories, Inc.

292 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition. Wright Chemical Corp.

293 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and feedwater system, condensate returns. % Proportioneers, Inc. %

294 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blow-down adjustment, test control. Describes equipment. Dearborn Chemical Co.

295 Feedwater Treatment — Here is a 10-pp illustrated report on boiler feedwater treatment for a high-pressure, high-makeup power and steam producing plant. It is based on studies to determine best method of meeting requirements for both the high-pressure steam used in power generating turbines and the district heating steam for downtown Philadelphia. Graver Water Conditioning Co.

296 Microbiological Control — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary aspects of industrial water treatment. Wallace & Tiernan Co., Inc.

OTHER EQUIPMENT

297 Equipment For Buildings and Institutions — Bulletin WP-1099-B27M is a 20-pp revised booklet of condensed information on sizes, dimensions, capacities, ratings and features, of a wide-range of equipment. Covers air conditioning and refrigeration products, with auxiliaries; oil, gas and dual fuel engines, deaerators and deaerating heaters; water conditionings; steam turbines and turbine genera-

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tors; liquid meters; centrifugal and other pumps. Worthington Corp.

298 Mechanical Draft Fans — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. The Green Fuel Economizer Co., Inc.

299 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

300 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures, steam nozzles. Foster Wheeler Corp.

301 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's Ljungstrom preheater. The Air Preheater Corp.

302 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. Also discusses other advantages, including eliminating need for tall stacks. L. J. Wing Mfg. Co.

303 Feedwater Heating System — This bulletin describes a flash-type deaerating feedwater heating system offering flexibility in the use of steam at different levels. The Whitlock Mfg. Co.

304 Turbine Generators — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical installation arrangement. Elliott Co.

305 Chemical Cleaning Service — Reduced maintenance costs and outage time are among advantages of company's chemical cleaning service for steam equipment and water lines discussed in this 8-pp bulletin. Before-and-after photos show some actual cleaning jobs. Dowell Inc.

306 Hydraulic Equipment — Circular 50-A, 6 pp, describes and pictures hydraulic jacks, hydraulic high-pressure and test pumps, and hydraulic units for forcing, pressing, pulling, etc. Includes application suggestions, material specifications, capacities. Richard Dudgeon Inc.

Postage-free cards for ordering catalogs and bulletins are provided on pages 35 and 138

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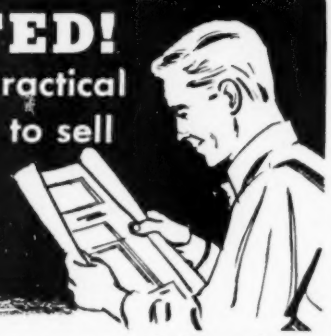

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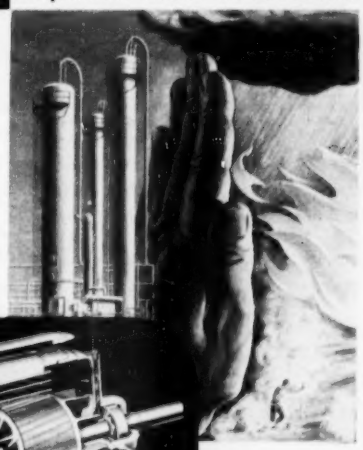

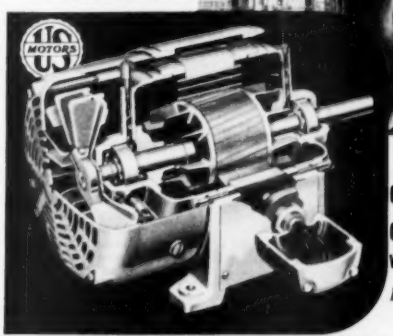

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ALL FORGED STEEL

Edward UNIVALVES

Lower Pressure Drop 25-50% with Straight-Thru Flow

As shown photographically here, the streamlined internal contours and the inclined stem construction of the Edward Univalve give straight through flow — which careful laboratory tests have shown to result in pressure drop 25 to 50% lower for Univalves than other globe valve types. Turbulence, too, is greatly lowered by these streamlined contours. And lowering turbulence lengthens valve life by eliminating vibration, the principal cause of wear in small globe valves.

But lower-pressure drop and less turbulence are not the only reasons the Univalve has become an industry standard for tough high pressure, high temperature services. Here are just a few of the benefits which add up to longer life and lower maintenance for this outstandi[illegible]raged Steel Valve.

LONGER PACKING LIFE **through a positive backseat and deep cooling chamber which protects packing in service. Isolation of packing prevents blow-out when repacking under pressure.**

PERFECT ALIGNMENT, EASY DISASSEMBLY **when necessary, through foolproof patented body-bonnet connection.**

EXTRA WEARING SEATING SURFACES— **seat formed by application of continuous ring of Stellite to valve body; Stellite hard-facing applied to alloy steel disk.**

EASY PACKING ADJUSTMENT **with through bolted, accurately guided gland.**

EFFORTLESS SEATING **with Impactor handwheel in sizes 1¼ in. and larger.**

DESIGNED FOR HIGH-PRESSURE, HIGH-TEMPERATURE APPLICATIONS
Two different classes rated for 1500 lb sp at 1023F or 2500 lb sp at 1033F.

AVAILABLE IN A WIDE RANGE OF SIZES
Furnished in 1500 lb or 2500 lb pressure classes in sizes from ½ in. to 2 in.

CHECK VALVES, TOO
Check type Univalves, of spring loaded piston design, have the same basic construction as globe Univalves. Use them together for all welded construction for small pipe lines, eliminating all bonnet joint leakage problems.

IDEAL FOR BLOW-OFF SERVICES
Univalves meet all ASME code requirements for blow-off service and are adaptable for high pressure installations to 3120 psi boiler pressure.

Get the full story on Univalves, ideal all-purpose steel valves—write for Catalog 12G1.

Rod through Univalve demonstrates straight thru flow of this valve.

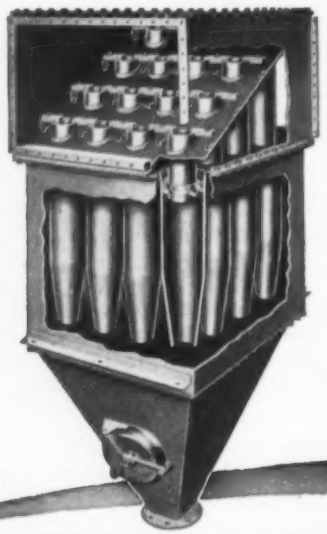
Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

220 West 144th Street, EAST CHICAGO, INDIANA

Another **Product**

Before you buy *any* equipment for recovering fly ash . . .



COMPARE ALL OTHERS against MULTICLONE'S Multiple Advantages

Because the advantages of MULTICLONE are so clear-cut, so vitally important, so far-reaching in the savings they make, we urge you to make a factual unbiased comparison of MULTICLONE fly ash collection equipment against *any other* in the mechanical recovery field. Only by making such a comparison can you fully appreciate the major savings and greater performance you get by installing MULTICLONE Collectors!

COMPARE Recovery Efficiency!

It is a recognized fact that the separating efficiency of a cyclonic tube increases as the tube diameter decreases because smaller tubes generate greater centrifugal forces. The patented vane in the MULTICLONE makes the use of small tubes *practical* without complicated manifolding and permits compacting many small tubes into one simple, highly efficient unit. MULTICLONE's higher centrifugal forces throw out not only the large, medium and small particles, but also an unusually high percentage of the *extremely small* particles of 10 microns and less. Result—*more complete recovery of all suspended particles from the gas stream!*

COMPARE Space-Saving Compactness!

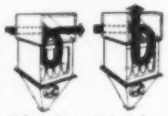
Plant space costs money—particularly at today's high construction costs. Because the MULTICLONE is more compact, size for size, it makes *really important* savings in space and plant costs. Note in the chart how the MULTICLONE requires substantially less space—*both in floor space and cubic space*—than any other unit of comparable capacity and performance. *This means vital savings in construction costs!*

Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

COMPARE Dollar-Saving Adaptability!

Savings in space is just one of many ways MULTICLONE reduces installation costs. Because the shape of the unit can be readily varied (long and narrow, short and wide, or square) to fit available spaces, the MULTICLONE can often be tucked into odd corners and waste areas too restricted for other equipment.

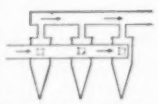
Moreover, inlet-outlet ducts can be varied—side-inlet side-outlet, or side-inlet top-outlet—to meet low headroom or restricted side clearance requirements . . . and the single-inlet single-outlet duct design permits greater flexibility and simpler installation. *These all add up to vital savings in installation costs!*



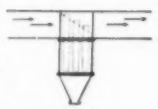
Side inlet, Side outlet ***Side inlet, Top outlet***

COMPARE All-Around Simplicity!

The MULTICLONE is simple and inexpensive to maintain because there are no highspeed moving parts to repair or replace . . . no pads or filters to clean or renew . . . nothing to choke the gas flow or increase draft losses as suspended materials are recovered. In addition, the square, flat-sided shape of the MULTICLONE and its straight inlet and outlet ducts are far simpler to install and insulate. And since the recovered material from an entire bank of tubes is collected in a *single* hopper, it is much easier to service and maintain than the multiple hoppers of conventional cyclone units. *Here again, the MULTICLONE saves in many ways—all of them important!*



Conventional Cyclone



Multiclone

Whether your recovery installation is in a new structure or for modernizing present equipment, you will be far ahead by installing MULTICLONE Collectors. Our experienced engineers will gladly make helpful suggestions for simplifying your recovery problems. A letter, wire or call to our nearest office places this assistance at your service without obligation.

Send for Helpful Literature! This factual MULTICLONE literature explains the basic principles of cyclonic dust recovery and gives technical data helpful to anyone contemplating a dust or fly ash recovery installation. Write today for your free copy!

WESTERN Precipitation CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1029 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
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PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

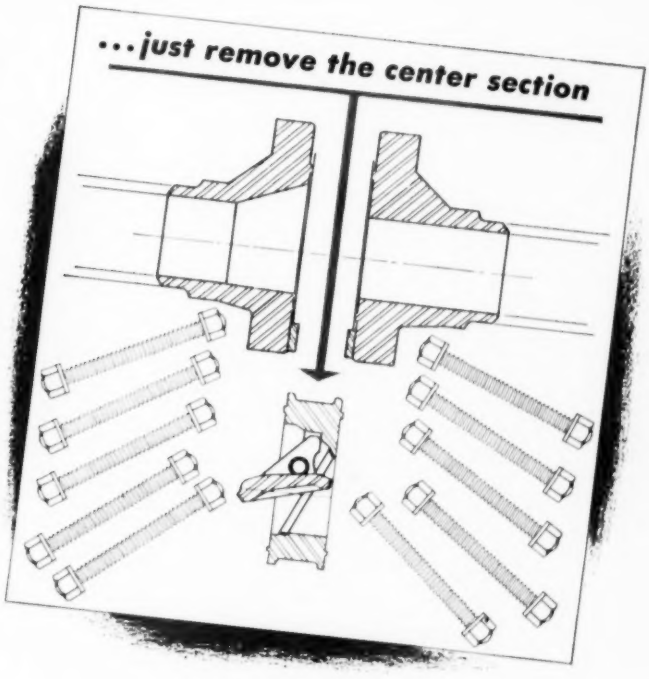
For more data circle 598 on Post Card

NO NEED to cut this valve out of a Welded Line

...it's a CHAPMAN 3-PIECE TILTING DISC CHECK VALVE

Remove studs between inlet and outlet ends. Then the whole center section can be slipped out *as a unit* . . . and quickly and easily replaced. Figure the savings for yourself!

Here, Chapman design gives you the smooth operation and quiet closing of the 2-piece Tilting Disc Check Valve . . . with the unique advantage of practically immediate interchangeability of "the works." And *only* Chapman makes this complete line of Tilting Disc Check Valves. Send for your Chapman "Check Book" — *now!*



The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

For more data circle 599 on Post Card

Why this turbine system has

NO RUST
NO SLUDGE
NO FOAM

THE turbine shown is lubricated with *Texaco Regal (R&O)*. This is the oil that tests prove has *more than ten times the oxidation-resistance* of ordinary turbine oils, and far superior rust- and foam-inhibiting ability.

Because *Texaco Regal Oil (R&O)* does such a fine job of keeping turbine systems clean, you can count on keeping bearing temperatures normal and governor response instantaneous. You can also count on extra-long service from the oil itself.

There is a complete line of *Texaco Regal Oils (R&O)* . . . for every type and size of turbine, every operating condition. They meet the stringent requirements of all leading turbine builders.

Let a Texaco Lubrication Engineer show you the benefits of using Texaco Lubricants throughout your plant. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils (R & O)
FOR ALL TURBINES

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